

Popular Science

FOUNDED **MONTHLY** 1872

RADIO SECTION

PAGE 76

—
*Confessions of a radio
"Gyp"—How to build
a two-tube reflex set.*

—
*A "Radio Doctor" tells
you how to get the
most from your outfit.*



DECEMBER

An amazing new motor-hoop of the speedway

25 CENTS

Thrilling escapes of a lion-hunter (See p. 38)



YAY—a touchdown!

Radiola Regenoflex

with compartments to hold the batteries; with 4 Radiotrons WD-11 and Radiola Loudspeaker. Complete except batteries and antenna . . . \$191

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Mickey over the line! Listen to 'em cheer! 'Ray—Mick! Thousands at the game. Hundreds of thousands listening in! Everybody's eager—excited—keeping young with new enthusiasms. Listening in!

It's great to get every word from the field—just as sharp and distinct as if you stood beside the announcer. It's great to get music that comes from miles away, every tone and overtone mellow and clear. And these are the things that are making the fame of Radiola Regenoflex.

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“There's a Radiola for every purse” ®

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Address _____

Ⓢ This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

Popular Science Monthly

Most Wonderfully Illustrated Magazine in the World

DECEMBER, 1924; Vol. 105, No. 6

25 cents a Copy; \$2.50 a Year



Published in New York City at

250 Fourth Avenue

Coming Next Month

What do your dreams mean?—The latest psychological discoveries about one of the oldest of all human enigmas, told in understandable terms in a fascinating article. What dreams are, where they come from, and what they tell you.

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The two-cent trail of peril—A thrilling account of how brave men risk death every day in out-of-the-way places to deliver the letters you mail. Stories of their adventures in howling blizzards and over treacherous ice. A gripping romance of Uncle Sam's postal service.

Two sturdy mail carriers of southern Idaho, who constantly face death in howling blizzards to keep the mail moving



And more than 200 other fascinating articles and pictures, giving you all the news of radio and engineering, science and invention, strange and unusual things people are doing, together with practical ideas for the automobile, the home, the home workshop, and the use of tools and machinery.

POPULAR SCIENCE MONTHLY

Issued monthly. Single copy, 25 cents. Yearly subscription to United States, its possessions, and Canada, \$2.50; foreign countries, \$3. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Copyright, 1924, by the Popular Science Publishing Co., Inc. The contents of this magazine must not be reprinted without permission. In presenting in its editorial columns numerous stories of new products of applied science, POPULAR SCIENCE MONTHLY does not underwrite the business methods of the individuals or concerns producing them. The use of POPULAR SCIENCE MONTHLY articles, or quotations from them for stock-selling schemes is never authorized. H. J. Fisher, President; R. C. Wilson, Vice-President; O. B. Capen, Secretary and Treasurer

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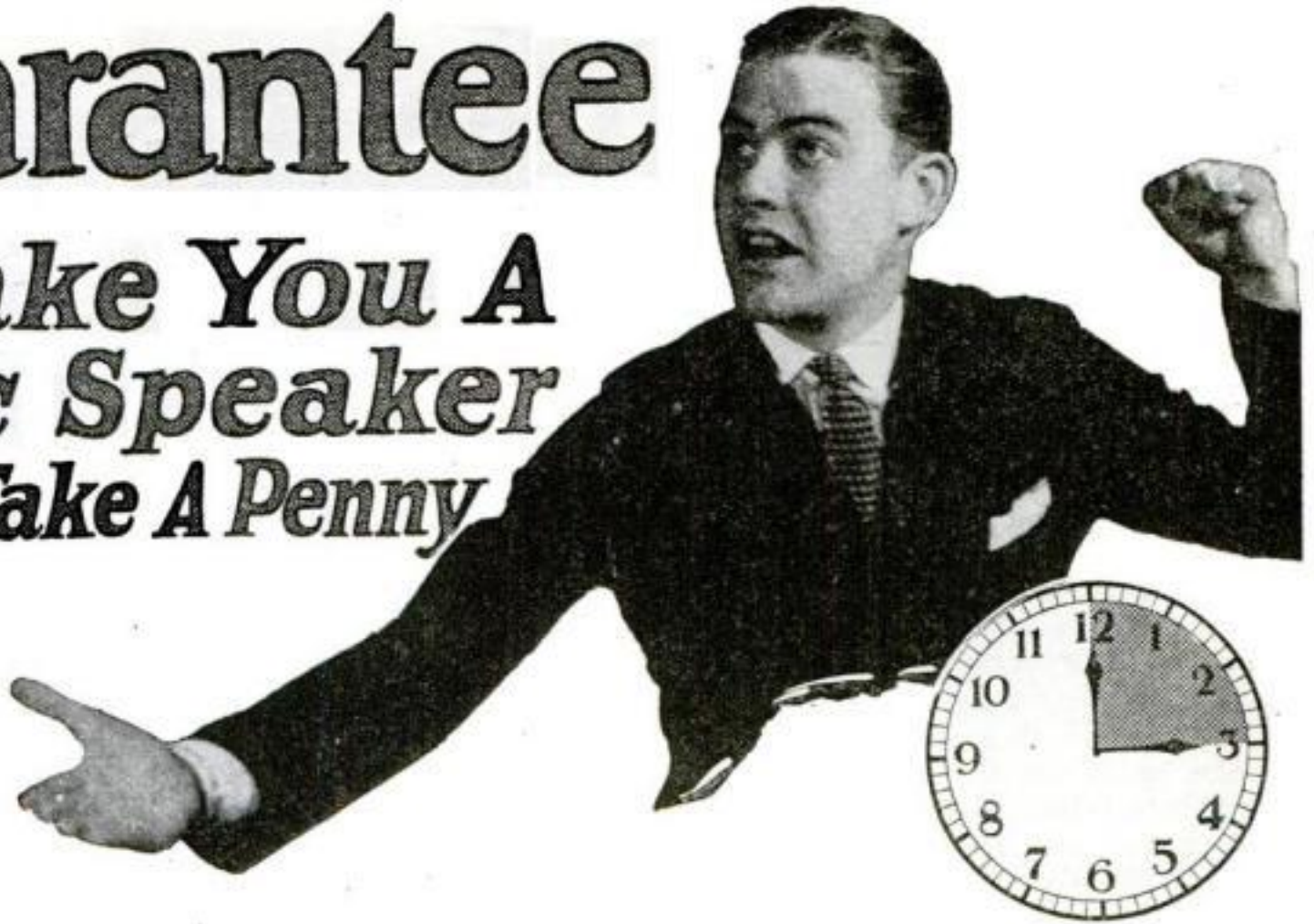
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- How to be master of any situation.

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Do Chiropractors Believe in Germs?

THAT germs exist is certain knowledge, but that they are the cause of disease is quite a different statement.

If the theory that germs are the primary cause of disease is correct, it follows that the introduction of germs into the living organism would produce disease in every case.

The instances that prove this untrue are so legion that the germ theorists have been compelled to explain that the germs are impotent **UNLESS THE POWER OF RESISTANCE OF THE PATIENT IS SUBNORMAL.**

Power of resistance may be measured in terms of life current or vitality. The stronger the life current, the greater the resistance and, vice versa, the weaker the life current, the weaker the resistance. So we may conclude that where 100 per cent of life current, or vitality, exists the susceptibility is zero; and where 50 per cent exists the resistance is small and the susceptibility correspondingly great.

It requires but little reasoning from these facts to conclude that those who contract typhoid, for instance, owe their susceptibility to a lack of vital force in the intestinal tract; those who contract tuberculosis, pneumonia, etc., to a lack of resistance in the lung tissue, and so on through the entire list of "germ" diseases.

Chiropractic goes several links farther back in the chain of cause and effect. While the germ theorists stop at the susceptibility of the patient, the chiropractor says that the susceptibility is the result of a lack of vital force, due to pressure on a nerve caused by a misaligned vertebra; and that when the vertebra is adjusted the normal vital force will again flow over the nerve, the affected parts will again

become normal and the disease germs and every other incidental effect will disappear.

Millions of people testify to the efficacy of Chiropractic in the so-called germ diseases. A fair trial at the hands of a competent chiropractor will convince you as it has convinced others.

CHIROPRACTIC CONQUERS TUBERCULOSIS



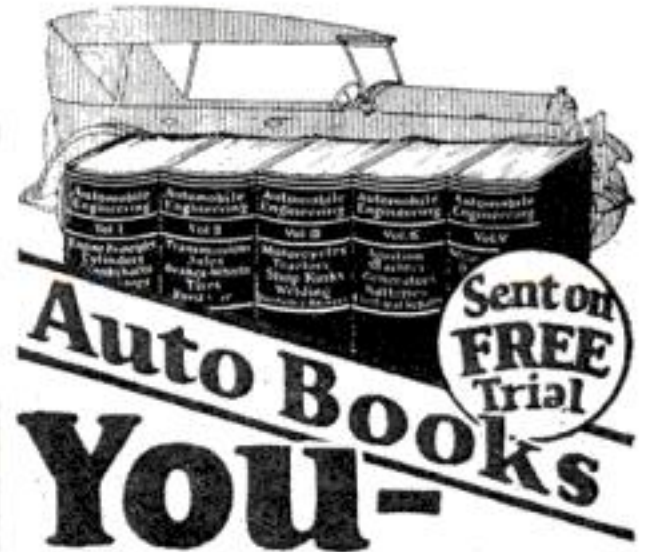
MR. AND MRS. KOEPESEL, of 913 Forest Ave., Waukegan, Ill., upon being first duly sworn, under date of August 11, 1923, depose and say:

"A marvelous change has been wrought in the condition of our little daughter, Betty Jane. She was taken sick when about nine months old and for four years we tried various treatments, but with no results.

"The condition of our little girl was getting worse and was diagnosed by physicians to be tuberculosis, and we were advised to change climate. Before doing this we considered trying Chiropractic. We laid aside all medicine and let the chiropractor have full sway from September 26, 1922, to January 26, 1923, at which time she seemed entirely well and has been improving ever since. Today her health is entirely restored. We owe her life to Chiropractic and shall always praise it highly for its wonderful science."

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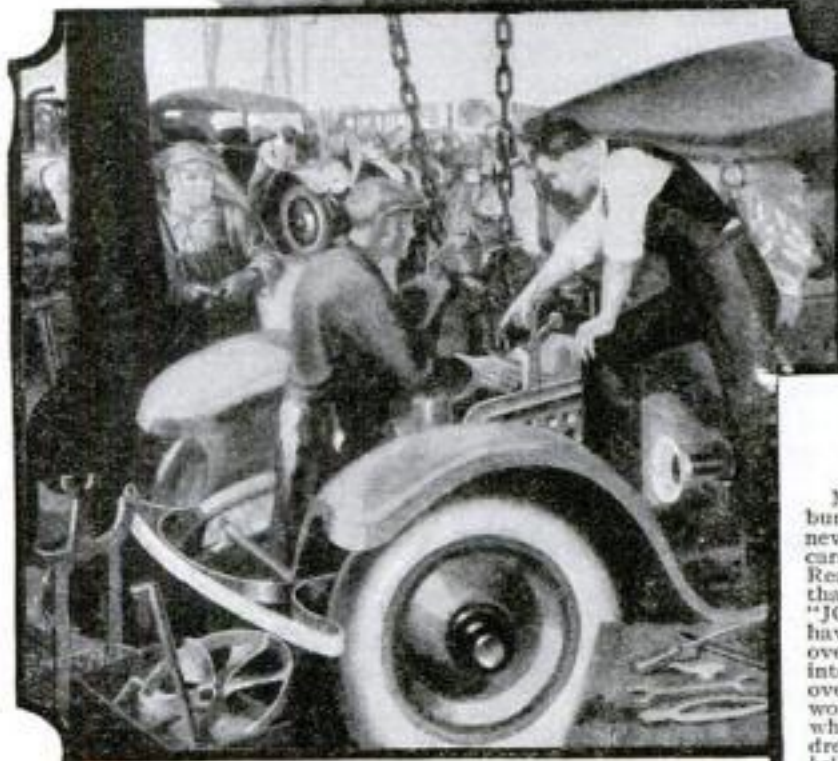
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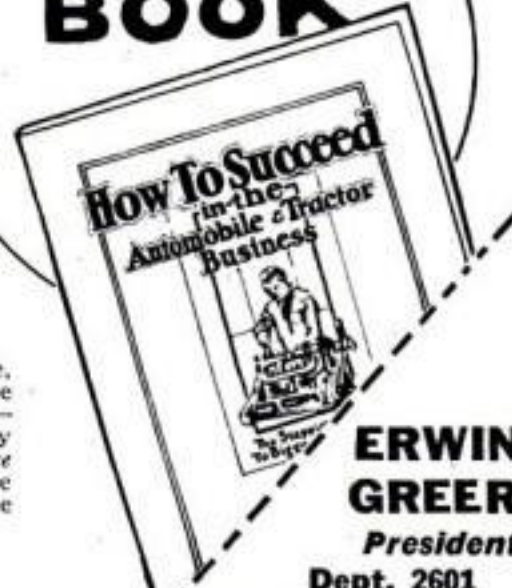
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A complete course in touch typewriting. You don't have to know how to operate a typewriter. You can learn to operate this machine in one day. We also give free a waterproof cover and all tools that come with a typewriter.



All Shipments made direct to you from our modern factory—the largest typewriter rebuilding plant in the world.

FREE BOOK COUPON

SHIPMAN-WARD MFG. CO.
2149 Shipman Bldg.
Montrose and Ravenswood Aves.
CHICAGO

Send by return mail your wonderful offer of Shipman-Ward Standard Rebuilt Underwood, also your book of facts. (This is not an order and does not obligate me in any way.)

NAME.....

STREET (or R.F.D. No.).....

POST OFFICE.....STATE.....

SHIPMAN-WARD MFG. CO.

2149 Shipman Bldg., Montrose and Ravenswood Aves., Chicago

ELECTRICITY

**Earn \$3500 to \$10000 a year
as an Electrical Expert**

What's Your Future?

Now you earn \$20 or \$30 or \$40 a week. In the same six days as an Electrical Expert you can make \$70 to \$200 and make it easier—not work half so hard. Why, then, remain in the small-pay game, in a line of work that offers no chance, no big promotion, no big income? Fit yourself for a “bossing” job—

Be An

**“Electrical
Expert!”**

Some Features of Cooke Training That Make SUCCESS Certain

1. Practical Money-Making Instruction—no useless, high-sounding theory.
2. Free Electrical Outfit.—Finest outfit ever sent out for home experiment and practical use.
3. Free Employment Service. (Helps you get a good job.)
4. Free Consulting Service. (No chance to get stuck on anything, while studying or afterward.)
5. Free Subscription to Engineering Magazine.
6. Free use of my big Electrical Laboratory and Free Room at the V. M. C. A. while visiting here.
7. Extra Courses Free—Radio—Electrical Drafting—Business—Automobile Electricity—Mine Electricity and Special Lessons on Health and Thrift.
8. Spare Time Work—Special earn-while-you-learn lessons.
9. Reduced prices on all Electrical Supplies.
10. Cash Refund Guarantee Bond.

These features are all explained in my big Free Book—the “Vital Facts.”

Today even ordinary Electricians—the “screw driver” kind—are making money—big money. But it's the trained man—the man who knows the whys and wherefores of Electricity—the “Electrical Expert,”—who is picked to “boss” the ordinary Electricians—to boss the Big Jobs—the jobs that pay \$3,500 to \$10,000 a year.

Neither L.L. Cooke nor the Chicago Engineering Works are connected, directly or indirectly, with any other school or Institution teaching Electricity or any other subject, by the Home Study method. You can only get “L. L. Cooke” training through the Chicago Engineering Works.



The “COOKE” Trained Man is the

NEEDS YOU!

*I will train you at home
to fill a Big Pay Job*

\$3,500 to \$10,000 a Year

Get in line for one of these "Big-Pay Jobs" by enrolling now for my easily learned, quickly-grasped, right-up-to-the-minute, Spare-Time Home-Study Course in Practical Electricity.

Age or Lack of Experience No Draw-Back

You don't have to be a High School graduate—it isn't even necessary that you should have finished the grades. As Chief Engineer of the Chicago Engineering Works, I know exactly the kind of training you need, and I will give you that training. My course in Electricity is the most simple, thorough, successful and practical in existence, and offers every man, regardless of age, education, or previous experience, the chance to become in a few short months, an "Electrical Expert," able to make from \$70 to \$200 a week.

Earn While You Learn

With me you do practical work—at once. In my first few lessons I show you how to make money doing Electrical work in your spare time. (Over half of my students are paying for their course in this way.) I show you also, how to get started in business for yourself, and then help you to get started.

FREE—Electrical Working Outfit—FREE

To do spare time work you'll need tools, etc. These I give you—Free—a whole kit including measuring instruments, a real electric motor (no toy), and other things—the greatest value ever given by any School.

Your Satisfaction Guaranteed by a Million Dollar Institution

I absolutely guarantee to return every penny paid me in tuition if, when you have finished my Course, you are not satisfied in every way with my instruction. And back of me, in my guarantee, stands the Chicago Engineering Works, a million dollar institution.

Nothing Like "Cooke" Training Anywhere

"Cooke" training is different because it's the most practical and most successful. It's best because it's backed up by the greatest Service to students ever known. It's this Service, plus "Cooke" training, that makes the "Cooke" trained man the "Big Pay" man everywhere. Become a "Cooke" Trained Man yourself, and earn \$12 to \$30 a day—\$70 to \$200 a week—\$3,500 to \$10,000 a year.

Investigate! Mail Coupon

Get the Vital Facts. Let me send you free my big new book on The Future of Electricity. Let me tell you more about the big demand for "Cooke" trained Electrical Experts. Sign and send me Coupon below.

L. L. COOKE, Chief Engineer
Chicago Engineering Works, Inc.

2150 Lawrence Ave.

Dept. 39

CHICAGO, ILL.

"Big Pay" Man!



Send for
this **FREE**
book

*The
Vital
Facts*

mail this coupon NOW

L. L. COOKE, Chief Engineer,
Chicago Engineering Works, Dept. 39,
2150 Lawrence Ave., Chicago, Ill.

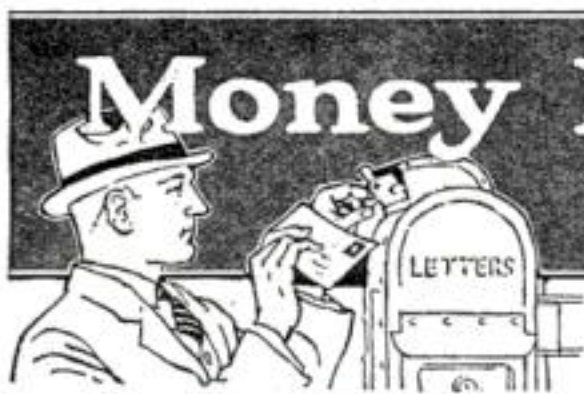
Dear Sir:—Send at once the "Vital Facts" containing Sample Lessons, your Big Book, and full particulars of your Free Outfit and Home Study Course—all fully prepaid, without obligation on my part.

Name.....

Address.....

City and State.....

Occupation..... Age.....



Money Making Opportunities for "Popular Science" Readers

Another \$25.00 IN PRIZES

To win one of these cash prizes is easy, and every reader is invited to enter this fascinating competition. Just write a letter of not over seventy words answering this question:—

What Advertisement of "Money Making Opportunities" in this issue interests you most and why?

Here are the prizes we will pay for the ten best letters answering the above question:—

First Prize \$10.00
Second Prize 5.00
Third Prize 3.00
And 7 Prizes
of \$1.00 each 7.00

First read every one of the "Money Making Opportunities" advertisements on pages 10 to 29. Check the ones that interest you. Then read over the ones you have checked and decide on the one that interests you most.

Then write a short letter, not more than seventy words, telling us why the advertisement you pick interests you most. Remember that ten prizes will be awarded. You have a good chance of winning one of them. Be sure to mail us your answer before Dec. 1st. The prizes will be awarded, in the order of their merit, for the letters that are most interesting and best expressed.

The names of all the prize winners and the letters that win the first two prizes will be printed in this column in the February issue. Address your prize letter to

Contest Editor

POPULAR SCIENCE MONTHLY
250 Fourth Ave., New York City

Last Month's Prize Winners

The first prize of \$10.00 goes to Mr. F. C. Phillips of Cincinnati, Ohio, for his letter regarding the advertisement of the Press Reporting Syndicate. Mr. Phillips' letter follows:

Dear Sir:

Opportunities satisfy when they fit one's case. "Money Making Opportunities" are opportunities that fit—thirty cents a word messages fraught with value to an audience so widespread that only Popular Science Monthly can reach it. But the Press Reporting Syndicate thus broadcasts the message that interests me most, for I am a student who needs some odd time employment that yields good returns—and here it is, agreeable, honorable, and worthy.

FRANCIS C. PHILLIPS.

The winner of the Second Prize—\$5.00,—is Mr. N. K. Reynolds, Spruce Creek, Pa. Mr. Reynolds wrote about the advertisement of the Novelty Cutlery Company. Here is his letter:

Dear Sir:

The Novelty Cutlery Company's ad justifies the old adage "Use little things to get big ones." Though small in size, it offered a big opportunity for what I most needed—increased income through spare-time work. With me, confidence in a publication is a pre-requisite of confidence in an advertiser. Trust in Popular Science Monthly plus the genuine appeal of the ad itself, made it doubly interesting.

N. K. REYNOLDS.

The Third Prize goes to Mr. R. Melrose, St. John, N. B., for his letter on the advertisement of the Metallic Letter Company.

The winners of the other seven prizes are:

C. E. Volkers, Terre Haute, Ind., Miss B. Rice, Sterling, Ill., Kenneth Totten, New Providence, N. J., Mr. B. Bray, Davis, Oklahoma, H. A. Mincher, Youngstown, Ohio, E. C. Armbruster, Oak Park, Ill., Miss K. Booth, Monrovia, Cal.

Rate 30 Cents a Word. A 10% discount is allowed on all contracts for six consecutive insertions. Advertisements intended for the February issue should be received by December 5th.

RADIO AND SUPPLIES

68 STATIONS on Crystal without tubes or batteries. You fellows who haven't tried my hook-up don't know what you are missing. Write, Leon Lambert, 670 Volusia, Wichita, Kansas.

RADIO tubes, D11, D12, UV199, UV200, UV201A, \$4.25. Dutch radio tubes, D12, D200, D201A, \$2.50. Crystal set, 50c. Add postage. Radio Sales Co., 1168 North Kingshighway, St. Louis, Mo.

RADIO Generators: 500v 100 watt, \$28.50. Battery Charging Generators, \$8.50. High Speed Motors. Motor Generator Sets all sizes. Motor Specialties Co., Crafton, Penna.

2,650 MILES Distance with one tube. Any Novice understands our Simplified Instructions, including Panel Layout and Photo, 25c. Vesco Radio Co., Box PS 117, Oakland, Calif.

BLUR Generators new 6 volts maximum output 22 amp. 2000 r. p. m. with cutout suitable charging a battery. Government surplus, \$10.00. Cook County Sales, 2456 Calumet, Chicago.

CASH in on Radio! Build and sell sets for us. No trouble to earn \$5 an hour in spare time at home. Auburn Radio Co., Dept. G, Cincinnati, O.

RADIO World National Illustrated Weekly. Solves all radio troubles. List stations, advance programs for full week, Great Q. and A. Dept. All dealers. Specimen Copy, 15 cents. \$6 year; \$3 six months, \$1.50 three months. Special: \$1 for 8 issues. Radio World, 1493 Broadway, N. Y.

EDUCATIONAL AND INSTRUCTION

DRAFTING, Tool Designing and Mathematics taught by mail; combined course or separate subjects. Harding School, Box H, Highland Park, Michigan.

BE a detective. Excellent opportunity to earn big money, travel, thousands of dollars offered in rewards. Established 1909. Particulars free. Write to C. T. Ludwig, 424 Westover Bldg., Kansas City, Mo.

LINCOLN-JEFFERSON University. Home Study in Academy College, Theological, Law, Music, Pharmacy, Business and Graduate schools, leading to degrees. Box G, Capitol Building, Chicago.

CORRESPONDENCE Courses solid complete; 1-1 usual prices because slightly used; easy terms; money back guarantee. All schools and subjects. Write for special Free catalog. Courses bought for cash. Economy Educator Service, N-202, West 49th St., New York.

ALL men, women, boys, girls, 17 to 65, willing to accept Government Positions, \$117-\$250, travelling or stationary, write Mr. Osment, 295, St. Louis, Mo., immediately.

RAILWAY mail clerks, \$133-\$192 monthly. Many other openings, \$117-\$250 per month. Information free. Write immediately. Chicago Civil Service College, T-70 Kesner Building, Chicago.

DOUBLE entry bookkeeping mastered in 60 hours; guaranteed; diploma. International Bookkeeping Institute, Springfield, Missouri, Desk 10.

USED correspondence school courses save over half Bargain catalogue 1000 courses free. Used courses bought. Students' Exchange, Dept. A, 47 West 42d Street, New York.

DETECTIVES Earn Big Money. Excellent opportunity. Travel. Fascinating work. Experience unnecessary. Write, George Wagner, former Government Detective, 1968P Broadway, N. Y.

HIGH School, Normal, Business, Law and Collegiate courses thoroughly taught by mail. Typewriting course free. Apply Carnegie College, Rogers, Ohio.

FIREMEN, Brakemen, Baggage men, Sleeping car, train porters (colored) \$140-\$200. Experience unnecessary. \$38 Railway Bureau, East St. Louis, Ill.

PREPARE for hotel positions, paying \$150 to \$500 monthly. Trained men and women in demand. We train you and help secure position. Prepare at home; spare time. Cost moderate; terms easy. Write for Free Booklet 300. Standard Business Training Inst., Buffalo, N. Y.

RAILWAY Postal Clerks, \$1,600 to \$2,300 year. Men, 18 up. Steady work. Common education sufficient. 25 coached free. Write immediately. Franklin Institute, Dept. S 39, Rochester, N. Y.

TRADE AND TECHNICAL SCHOOLS

EARN ten to fifteen dollars per day laying brick. Any intelligent man can become a bricklayer with three months training in our school, and three to six months practical experience, during which he can earn 60 to 90 cents per hour. No age limit. Tuition reasonable. Send for catalogue. Associated Building Employers, 128 A. B. E. Bldg., Grand Rapids, Michigan.

\$10 TO \$20 per day. Practical courses in Sign-Pictorial-Auto Painting—Decorating—Graining—Marbling—Paperhanging—Low Cost—Catalog Free. Chicago Painting School, 152 W. Austin Ave., Chicago, Ill.

LANGUAGES

WORLD-ROMIC System, Masterkey to all languages. Primers, \$1.94; Chinese, French, Spanish. Pronunciation-Tables, 30c. Dictionaries, \$1.98. Languages, 8 West 40th, New York.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

WANTED—Representatives in every factory in the United States. Popular Science Monthly, 250 Fourth Ave., New York.

**More Money Making Opportunities
on pages 12 to 29**

CARPENTRY

SELF TAUGHT!!

Be A SKILLED Workman and Hold Your Job in Dull Seasons



Do you know that even when work seems hardest to get, building contractors are complaining that they can't get enough skilled carpenters? Almost any man that says he is a carpenter can get a job in the building season, but it depends on what a man *KNOWS* whether he gets laid off at the first dull week or not. Spare time reading and study of AUDEL'S GUIDES will help make you the kind of skilled workman that is never out of a job.

New Ideas - Modern Methods - Short Cuts

This course "Audel's Guides for Carpenters and Builders" consists of 4 handy volumes of over 1500 pages with thoroughly illustrated charts, diagrams, graphs, pictures with calculations for every job from making the excavation to constructing the entire building. You will find these new Guides most complete and comprehensive in addition to being both timely and practical. There are 3700 actual examples of efficient construction work with new methods, ideas, solutions, plans, systems,

short cuts, time and labor saving suggestions, new ways that cover the entire theory and practice of the subject illustrated by sketches and forms all specific and practical. Audel's Guides give you the short cut, professional information you want. No need to guess or take chances. Every day you have before you in this set the exact, practical, useful information that will help you with every job that comes up in your daily work.

Thousands Say Guides Are Carpenter's Best Friend

"Reasonable Price"

I find the Guides very satisfactory. The knowledge in them is much greater than I anticipated. A very convenient size and price is so reasonable that every carpenter should possess a set.—Ralph M. Collemmer, Lowell, Mass.

"Valuable for Beginners or Old Timers"

I have looked over my Audel Guides and find a wealth of information. Their size makes them very handy to carry right onto the job. I have put my books in my tool kit and have them

for ready reference. The arrangement of subjects and the simple way it is explained make the books very valuable for the beginner. The rules and formulas are mighty handy for the old timers.—Ross Smith, Sommers Point, N. J.

"Good For Professional Carpenters"

It is the most handy reference work that I ever came in contact with. It is the very thing that the building mechanic needs every day for reference. I wish to state further there is not a

foreman or superintendent who can afford to be without this valuable work. I wish you unbounded success.—George H. Watson, 136 Munson St., Long Island City, N. Y.

"Guides Save Hard Knocks"

The Guides are truly wonderful and should be in the hands of all young carpenters as well as a lot of the older heads. If I had such information 20 years ago they would have saved me many a hard knock and also sleepless nights trying to

figure out the next day's work.—G. M. McJohnston, R.R. 1, Hammond, Ind.

"Save Money"

The Guides have met with my complete satisfaction. Anyone expecting to build a home can well save \$150 or more by using the information given in your books. W. E. Frantz, Box 77, Tuscarawas, Ohio.

"Good For Amateurs"

The books are surely worth more than the purchase price; especially as they serve as a

guide to the non-professional like myself who is trying to build himself a home at the least expense.—Otto F. Schulze, P. O. Box 143, Westmont, Ill.



Condensed Contents of Audel's New Guides

Guide No. 1—Over 341 pages—1200 illustrations

- How to know the different kinds of wood.
- How to use the different kinds of wood.
- Complete detailed information on nails and screws.
- How circular and band saws are handled.
- How to use the steel square.
- How to sharpen tools.
- How to file and set saws.
- How to make wood joints.
- Complete information regarding joints and joinery.
- How to build furniture.
- How to make a work bench.
- How to make a mitre box.
- How to make a mitre shooting board.
- How to plumb and level work.
- How to use the chalk line.
- How to lay out work.
- How to use rules and scales.
- How to use all of the carpenter's tools, with over 900 illustrations showing specifically how.

Guide No. 2—Over 455 pages—400 illustrations

- How to understand carpenter's arithmetic.
- How to understand geometry.
- How to understand trigonometry.
- How to solve mensuration problems.
- How to estimate the strength of timbers.
- How to proportion beams.
- How to use drawing instruments.
- How to read plans.
- How to survey.
- How to draw up specifications.
- How to estimate cost.
- How to build houses, barns, garages, bungalows, etc.

Guide No. 3—Over 255 pages—400 illustrations

- How to excavate foundations.
- How to build foundations.
- How to make water-proof.
- How to erect post foundations.
- How to build forms for concrete.
- How to proportion foundation footings.
- How to frame houses.
- How to set girders and sills.
- How to frame joists.
- How to construct a well hole.
- How to frame a studding.
- How to frame corner posts.
- How to lay out and cut braces.
- How to attach lath to corner posts.
- How to frame temporary and permanent braces.
- How to frame girts and ribbands.
- How to set window frames.
- How to frame partitions.
- How to distinguish various types of roofs.
- How to use the settings 12, 13 and 17 on the steel square.
- How to lay out mitre cuts.
- How to use tangents, and full detailed information covering sky lights, scaffold and hoisting.

Guide No. 4—Over 448 pages—400 illustrations

- How to put on wood, fibre and metal shingles.
- How to lay gravel roofs.
- How to lay tin roofs.
- How to hang doors.
- How to frame windows.
- How to put on siding.
- How to put on exterior trim.
- How to do cornice work.
- How to build stairs.
- How to lath.
- How to lay floors.
- How to put on interior trim.
- How to paint.
- How to give first aid to the injured.

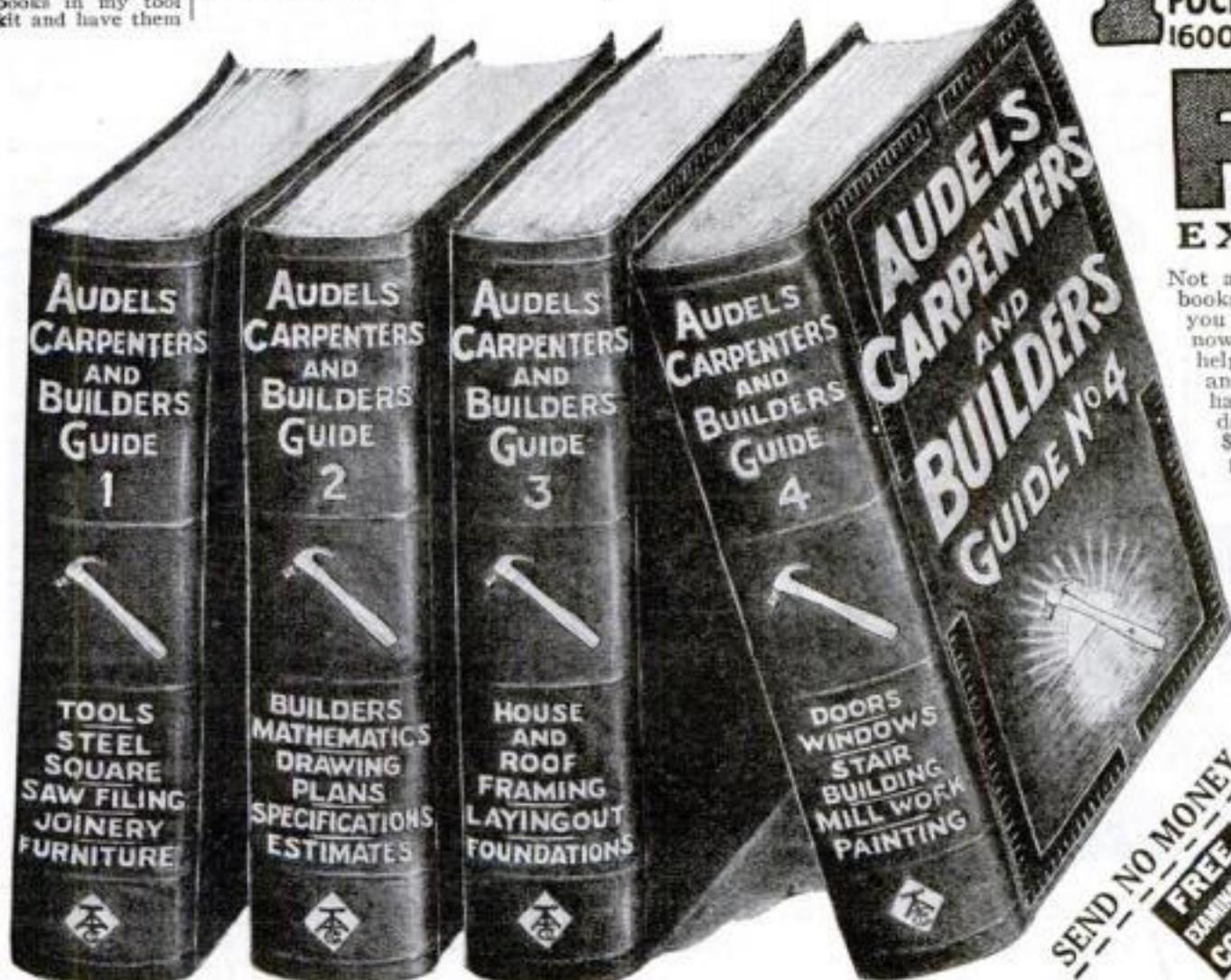
\$1 PER MONTH-ENTIRE SET \$6
FREE EXAMINATION
POCKET SIZE-FLEXIBLE COVERS
1600 PAGES-3700 ILLUSTRATIONS

FREE

EXAMINATION

Not a cent to pay until you see the books. No obligation to pay until you are satisfied. Send coupon now—today and get this fine, helpful new set for Carpenters and Builders. After you have looked them over 5 days send only \$1, then \$1 a month until \$6 is paid—if you want to keep them.

SEND NO MONEY—NOTHING TO POSTMAN—MAIL COUPON NOW!
FREE EXAMINATION COUPON
 Please submit me for approval and free examination of Audel's Carpenters and Builders Guides. If satisfactory I agree to send you \$1 monthly until \$6 is paid.
 Name.....
 Address.....
 Occupation.....
 Employed by.....
 City.....
 State.....
 Zip.....



Will you give me 6 MONTHS to increase Your Pay?

Your name on the coupon means "Yes"



No, I am not a wizard. I don't claim to have a "corner" on success, but here's a fact.

For fourteen years I have been helping men just like you to make more money, not just a few men here and there, but thousands of men.

Think these facts over—in just a few months time I boosted one man's pay from \$2.00 a day to over \$300 a month—another now makes as high as \$27.00 a day—another man, after securing my help, went into business for himself and, while he now hires his drafting done, he makes over \$50,000 a year.

\$275 Extra in Three Days

One man saw an ad like this—Sent in the coupon—Enrolled for the Columbia Course—and shortly after he received \$275 for one drawing that he made in his spare time in three days.

Do you make money like these men do? Does the money in your pay envelope get you the things you really want or just enough to make you wish you, too, could have the good things of life that other men have—money, independence, success, happiness?

MAKE \$50 TO \$100 A WEEK

Columbia will train you to be an expert Draftsman in your spare time at home by mail. There's a lot of room for you if you act now. This doesn't mean that you will be just an ordinary Draftsman, but a finished, Professional Draftsman, able to hold your place among the highest paid Draftsmen in the land.

PROMOTION IS QUICK

We'll qualify you for a high salaried position in the Drafting field and keep you in touch with openings for Draftsmen in the big machine shops, industrial plants and United States Government departments. Men who start as Draftsmen are often advanced to Chief Draftsmen, Chief Engineers, Production Managers, and so on. Many of my graduates are today holding such positions as a result of my help. These positions pay big money and lead on to executive positions of the highest type. Thousands of men have found Drafting to be the stepping stone to some of the biggest positions in American industry.

GET THE RIGHT TRAINING

I started this school years ago. Today it is a solidly established nationally known institution, with graduates all over the world. I stand personally in back of the Columbia School of Drafting and back of every promise, every statement we make.

COLUMBIA SCHOOL OF DRAFTING

Roy C. Claffin, President

Dept. G. 102, 14th and T Sts., N.W., Washington, D.C.

FREE BOOK COUPON

COLUMBIA SCHOOL OF DRAFTING
Dept. G-102, 14th and T Sts., N.W.,
Washington, D. C.

Please send me without charge your free illustrated book on Drafting, telling me how I can secure your help in securing a position as Draftsman. Also enter my name for free subscription to "The Compass."

Name.....
Address.....
City..... State.....

\$25.00 in PRIZES

See top page 10 in front of book for details

WANTED RAILWAY POSTAL CLERKS

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TRAVEL—See your country
MEN - BOYS, 18 UP

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Common Education Sufficient

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Dept. R-275, Rochester, N. Y.
Sirs: Send me without charge, (1) Sample Railway Postal Clerk Examination coaching lessons; (2) Schedule showing places of coming U. S. Government examinations; (3) List of many Government jobs now obtainable.
Name.....
Address.....

What I Give You

Free Book. Send in the coupon today. I will immediately send you our book "Drafting—Your Success" which tells about Drafting and its opportunities and contains proof that I can raise your pay.

Free Subscription to Drafting Publication, "The Compass." I will give you free a subscription to our helpful, inspiring publication, "The Compass."

Practical Problems. You will be carefully coached in practical Drafting work.

I Help You Get A Job. I will help you get a position as a practical Draftsman and will give you real, personal help, such as I have given to thousands of others.

Personal Instruction and Supervision, throughout the Course. You will receive the personal instruction and help of Roy C. Claffin, President of the Columbia School of Drafting and a practical Draftsman of many years' experience.

Draftsman's Equipment. I will furnish you with a full set of first class drawing equipment and Drafting instruments, as shown in the picture below, when you enroll. You keep both sets on completing the course.

Consultation Privileges. You are free to write me at any time for personal advice and suggestions regarding your progress.

Diploma. The diploma I will give you on completing the course attests to your proficiency as a Draftsman. It is an entering wedge to success.

Advice Regarding Government Positions. The following are a few of the many positions open in the Government Departments from time to time. The salaries are starting salaries, subject to increase:
Architectural Designer — \$4,000 a year.
Chief Draftsman, Naval Aircraft Factory — \$15.04 a day.
Aeronautical Draftsman, Field Service Navy Department — \$5.20 to \$12.00 a day.

We will advise you as to other government openings from time to time.



FREE DRAFTING OUTFIT
We give you free with our course this professional Drafting outfit. It is yours to keep when you complete the course.

Money Making Opportunities

FOR THE HOME

HOME weaving—looms only \$9.90. Big money in weaving rugs, carpets, portieres, etc., at home from rugs and waste material. Weavers are rushed with orders. Send for free loom book, it tells all about the weaving business and our wonderful \$9.90 and other looms. Union Loom Works, 482 Factory St., Boonville, New York.

GRANDFATHER clock works \$5.00. Build your own case, instructions free; make good profits selling your friends. Clock works with chimes for old or new cases. Write for full particulars. Clock Co., Nicetown, Penn.

FOR more heat from less fuel, less work tending furnace, even, steady heat at all times—attach the Crown Fuel Saver to your furnace. This inexpensive device is guaranteed to make a coal-saving of at least 20% or your money refunded. Write for booklet. C.F.S. Co., 14 N. 10th St., Richmond, Ind.

PURCHASE a beautiful Electric Fountain for your home at Jobber's price. Walter L. Haanel & Co., 4521 Ravenswood Ave., Chicago.

ADVERTISING

ADVERTISE in 24 metropolitan dailies, 24 words, \$15.00. Helpful Guide listing 1000 publications, 4c stamps. Wade Company, Baltimore Bldg., Chicago.

28 WORDS in 80 Country Town Newspapers, \$3.40. Shaw, 221 A. Northeast, Washington, D. C.

24 WORDS combine list of 70 Sunday and weekly newspapers, \$6.00. AdMeyer, 4112 P. Hartford, St. Louis.

WRITE for a copy of our "Quick-Action Advertising Rate Folder." It contains information of real value to you. Popular Science Monthly, 250 Fourth Ave., N. Y.

PRINTING ENGRAVING AND MULTIGRAPHING

GOOD Printing Reasonable. Name Card or Catalog. Few samples free. Get our prices. A. H. Kraus, Kraus Bldg., Milwaukee, Wis.

BETTER Printing for Less Money. Write us about your printing needs, and you will save money. Ernest Pantus Company, 525 South Dearborn Street, Chicago.

EMBOSSED business, personal stationery. Samples, stamp. Daniels P. Company, Pittston, Pennsylvania.

225 BOND Letterheads, Envelopes, Billheads, Cards, \$1.25 each. Combination \$4.00. Economic Printery, Leona, N. J.

125 EACH Bond Letterheads, envelopes, \$1.00. Lawrence Kenney, Oconto, Wis.

DRAWINGS and Cuts to order. Artist Cressman, Washington, New Jersey.

"ARISTOCRAT"—embossed stationery. Exclusive Reputation. Samples for stamps. Apex Company, 261 South Main, Wilkes-Barre, Pa.

AMERICA'S leading Mail Printers Want Your Work. We have every facility, we give you highest quality, lowest prices and guarantee satisfaction. Bond Letterheads and envelopes, 1,000, \$3.50; 5,000, \$14.50. Get our estimates on other work first. Chadsey-Meador Co., New London, Conn.

DUPLICATING DEVICES

STENCIL Duplicating Outfit—\$2.00, \$3.00, \$4.00. Prints Typewriting, Handwriting, etc. On Approval. Primos Specialty Co., 3-X, Primos, Pa.

OFFICE DEVICES

ADDRESSING machines, multigraphs, duplicators, folders, check writers, sealers, dictating machines, at about half new cost. Pruitt, 170-Z North Wells, Chicago.

ADDING MACHINES

FREE trial, marvelous free adding machine. Adds, subtracts, multiplies, divides, automatically. Work equals \$350.00 machine. Price only \$15.00. Speedy, durable, handsome. Five-year guarantee. Used by largest corporations. Write today for catalog and free trial offer. Lightning Calculator Co., Dept. O, Grand Rapids, Michigan.

MAIL ORDER BUSINESS

NEW Mail Order Plans in Business Progress each month. Trial 3 months subscription 25c, 734 Cherry St., Kansas City, Mo.

\$50 a week, evenings. I made it. Mail order business; booklet for stamp tells how. Sample and plan 25c. Free, 12 articles worth \$3. Alps Scott, Cohoes, New York.

BRANCH OFFICE SERVICE

PITTSBURGH Office and Representation Free. Pittsburgh Office Service, 973 Union Trust Bldg.

STAMMERING

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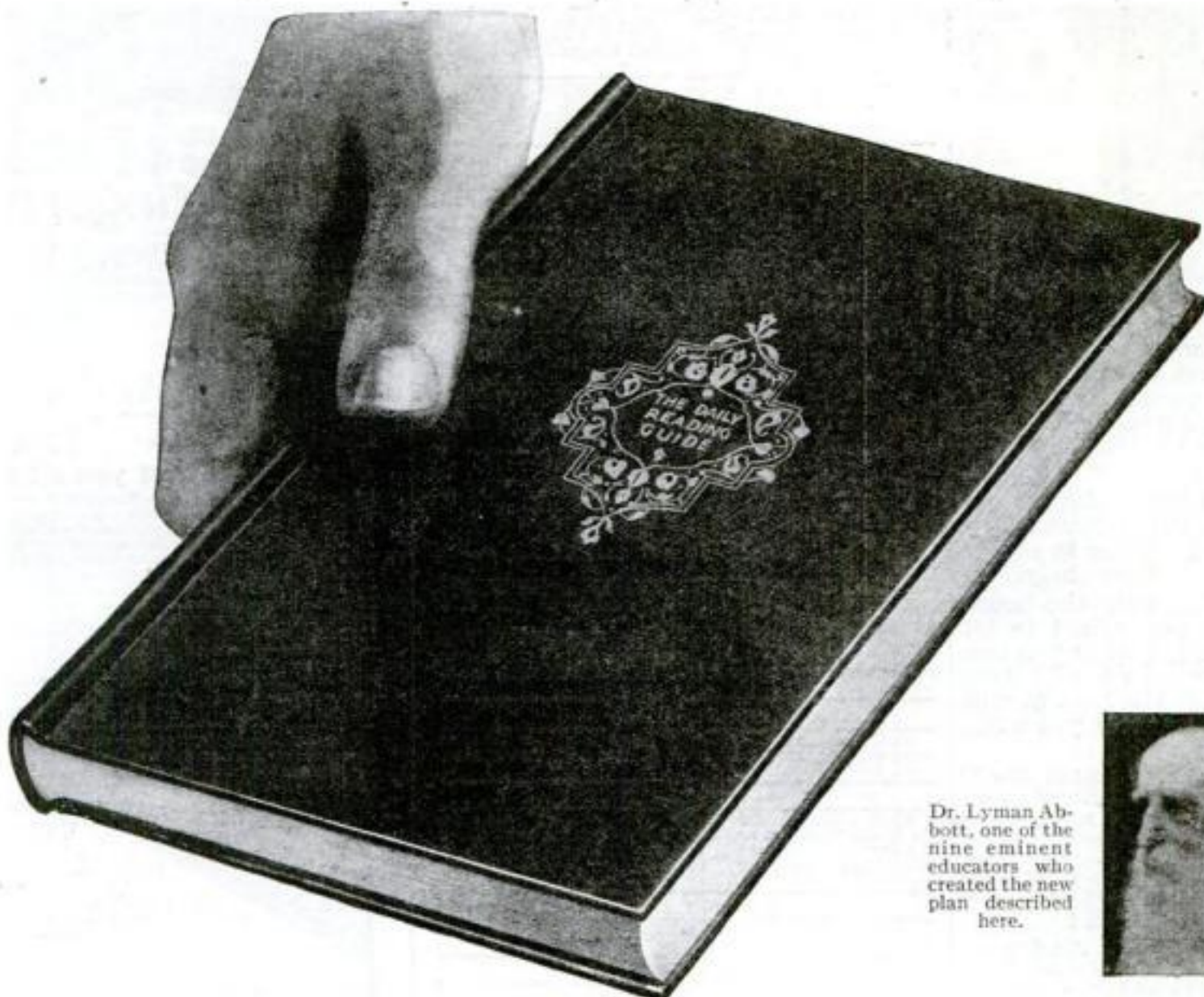
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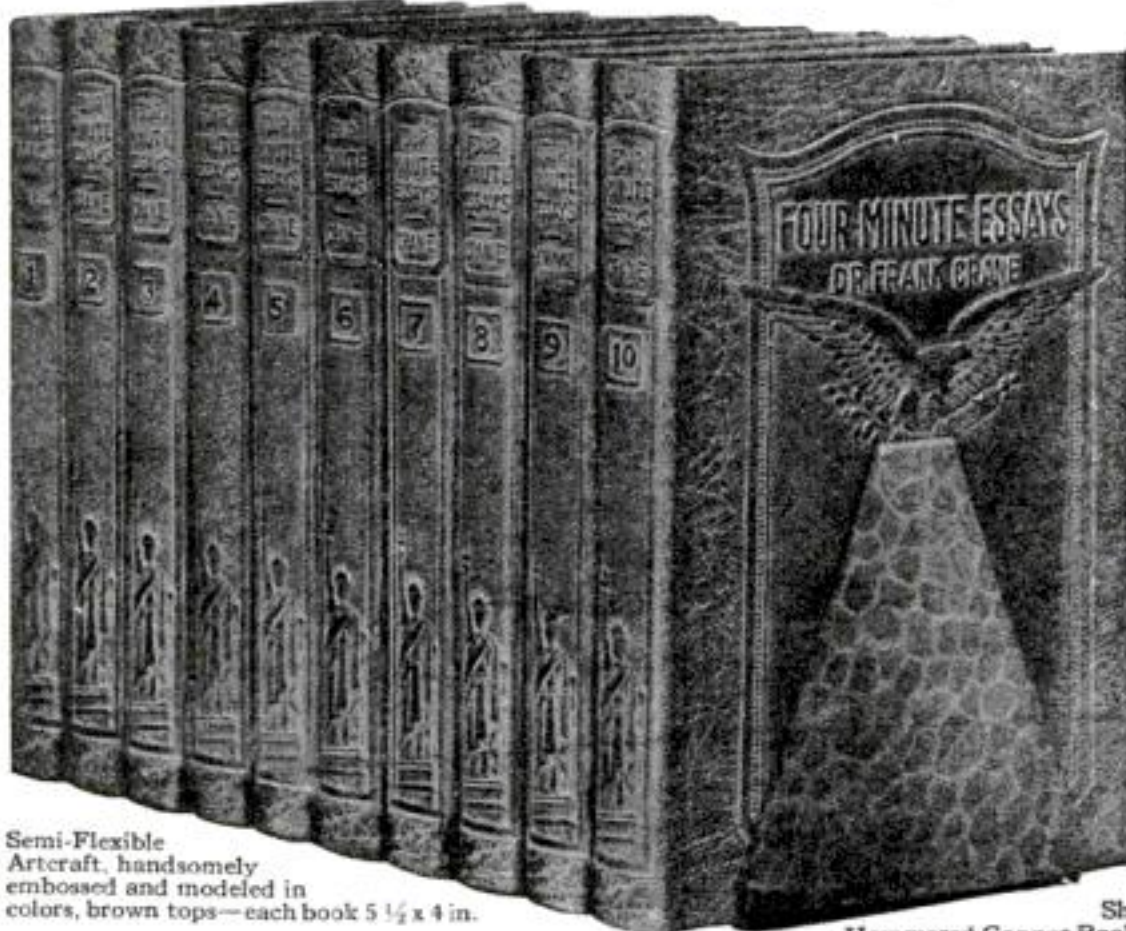
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More Money Making Opportunities
on pages 10 to 29

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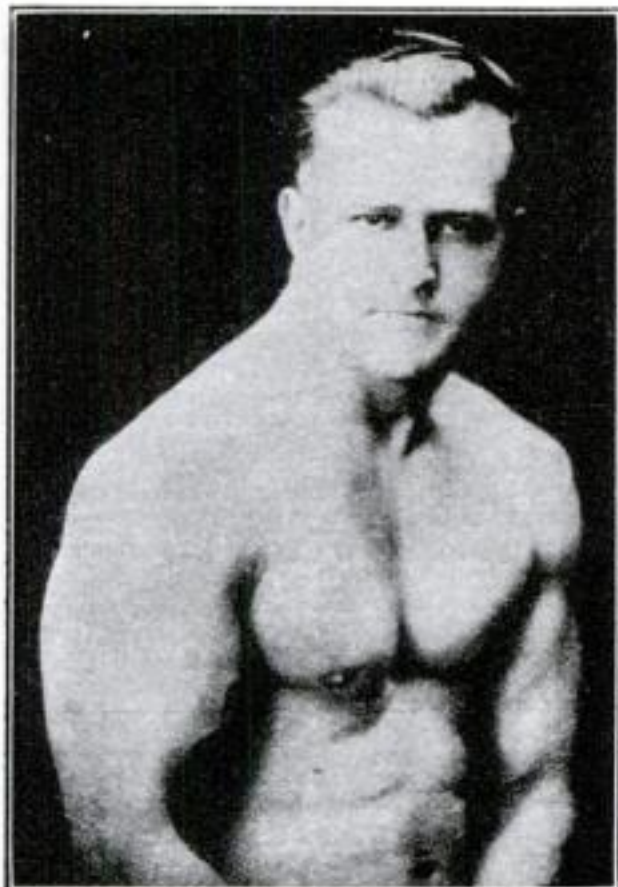
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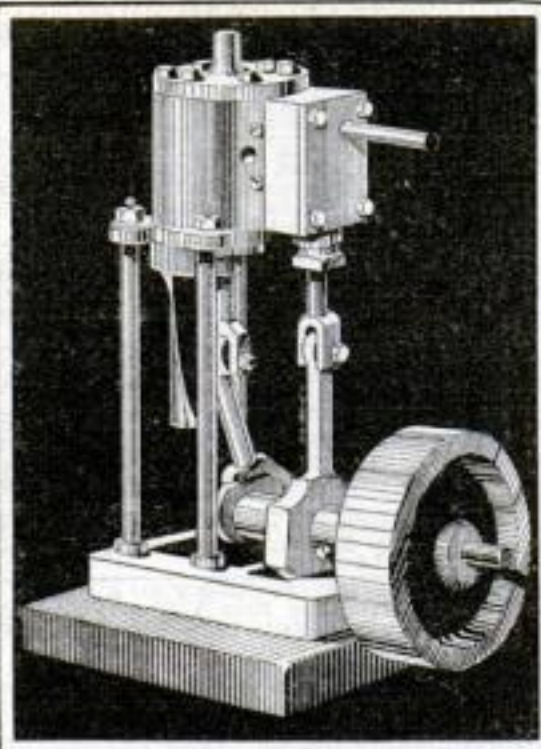
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YOU can make \$100 a week selling our new specialties: Ivoryplak and Lykoll Paintings—also complete line of Photo Novelties. 600% profit. Experience unnecessary. Perry Photo Novelty Corp., Sec. PS-12, 1793 Jerome Ave., New York.

SALESMEN: Sell guaranteed shoes for men, women and children below store prices. \$70.00 weekly easy. We deliver, collect. K-W Shoe Company, 4048 Harrison, Dept. 21, Chicago.

CLEAN Up \$100.00 weekly with our marvelous Christmas packages, selling from 50c to \$3. Great crew manager's proposition. Postal brings unique plans. Davis Products Co., Dept. 57, 1311 Carroll, Chicago.

AGENTS—Sell Gloss Oil Veneer—The Wonder Polish. Cleans and polishes cars, furniture, etc. Sells in every home. Get your field at once. Duo Co., Dept. G66, Attica, New York.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

More Money Making Opportunities
on pages 10 to 29

BARBERING

Now One of the Highest Paid Professions!

\$90 to \$150 Every Week!

BE A "WHITE-COLLAR" MAN—
Earn \$90 to \$150 a Week—CLEAN Money!

What's the use of doing dirty, greasy, hard work, when you can **NOW** make **TWICE** as much money in a manly profession that is **CLEAN**, profitable and full of opportunities?

Easy to Learn—
Quick to Earn!

That's **BARBERING** for YOU! And the best part of it all is this—scientific barbering, as taught the modern **MOLER** way, makes YOU a Master Barber in a short course of intensive training, at small expense! You soon step out as your own Boss, if you wish, in your own Shop, which we will gladly help you equip.

See the World,
Too!

Or, if you prefer, we will help you step into a real job, with good pay the first day, after you graduate. Ocean Liners, crack trans-continental passenger trains, big luxurious hotels and skyscrapers all over the world, as well as thousands of Barber Shops everywhere, demand **MOLER** trained men.

MOLER SYSTEM OF COLLEGES

30 Branches in United States and Canada

New York, N. Y.	Detroit, Mich.	Dallas, Tex.
Chicago, Ill.	Denver, Colo.	Houston, Tex.
St. Louis, Mo.	Omaha, Nebr.	San Antonio, Tex.
Kansas City, Mo.	Milwaukee, Wis.	Seattle, Wash.
Cincinnati, Ohio.	New Orleans, La.	Tacoma, Wash.
Cleveland, Ohio	Atlanta, Ga.	Spokane, Wash.
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MOLER Graduates
Are Always Busy!

MOLER trained Men are always given the preference, for they alone possess the valuable, thorough **MOLER** training in the application of all the latest scientific Barbering methods, including the Electric hair cutter, the mechanical massage, and the latest vogue in ladies' hair bobbing. **MOLER** also gives special training in ladies' marcelling and an easy practical course in the treatment of skin diseases.

Earn While
Learning!

"Where there's a Will there's a Way" to earn BIG pay! Write to the nearest **MOLER** College, there is one near you, and learn how you can earn while you learn the barber trade. Ask for the new **FREE MOLER** Barbering Booklet C. Find out **HOW MOLER** helps you help yourself AFTER you graduate, as well as BEFORE! Find out why **MOLER** Men are making **DOUBLE** the money others made last year, before Ladies' Shingle Bobbing became so popular. You're **NEXT** in line for big pay—the **MOLER** way. Send Coupon TODAY!



Mail THIS

MOLER SYSTEM OF COLLEGES

← Address Nearest Branch
(Street Address NOT Needed)

Please send me without obligation on my part your Booklet C.

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Address.....

City..... State.....

"STAMMERING

Its Cause and Cure"

You can be quickly cured. Send 10 cents for 288 page cloth bound book on Stammering and Stuttering. It tells how I cured myself after Stammering and Stuttering for 20 years. **BENJAMIN N. BOGUE**, 7512 Bogue Building, 1147 N. Ill. St., Indianapolis.

WRITE JOKES

Earn From \$50 To \$150 Per Week

writing jokes, epigrams and humorous stories for publications. Tremendous demand for material. Our short course in Humor Writing teaches you to write humorous material that sells. Learn in your spare time—earn in your spare time. Complete marketing plan and markets furnished.

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Office K, 319 Marion Bldg., Cleveland, Ohio



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If you're earning less than \$75 a week, GO INTO DRAFTING! I guarantee to train you AT HOME the "JOB-WAY"—with actual Drafting Room jobs. Send for my free book, find out about the wonderful opportunities to earn big money in this easy, fascinating business. Drafting experts are close to the boss—are first in line of promotion for executive positions.

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Common schooling all you need! I train you by my copyrighted "JOB-WAY" instruction. I train you thoroughly in Drafting by giving you actual JOBS to do. No books or useless theory to waste your time. My graduates are SUCCESSFUL—employers ask for Coyne-trained Draftsmen. So I guarantee satisfaction or to refund every penny of your money!

FREE! EXPERTS'

DRAFTING OUTFIT

You learn to do actual JOBS with the same instruments you will use when employed at a big salary. To encourage you to START RIGHT NOW, I will give you with my course this complete EXPERT'S outfit FREE. Coupon brings complete information.

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COYNE SCHOOL OF
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Dept. 937, 1920 Sunnyside Ave., Chicago

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Dept. 937, 1920 Sunnyside Ave., Chicago

Without obligating me in any way please send me your book, "Drafting, the Foundation of Industry," absolutely free. Also complete information of your rapid home-study Drafting course, Free instruments and special offer.

Name.....
St. No.....
City..... State.....

I make Champs

I can do for you what I have done for thousands in every branch of athletics—whether it be for pleasure or as a profession, I can guide you. Ask Charles Daniels, champion swimmer, Tim Jordan, home run hitter, Oswald Kirby, former golf champion, Harry Babcock, world's champion pole vaulter, and a long list of others. They will tell you that my system always starts a man right and keeps him right. My system never fails. Over 25 years as a trainer in all branches of sport is my record—and I can still make the present-day record holders step some to keep up with me.

28 Champs to my Credit



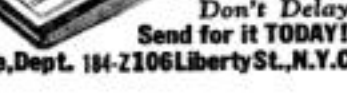
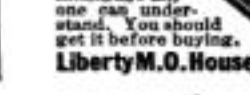
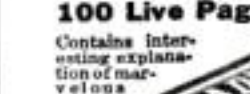
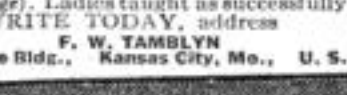
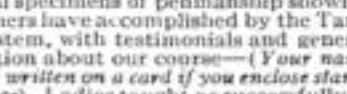
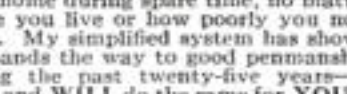
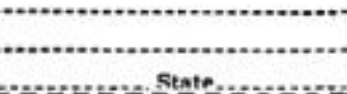
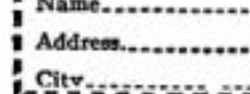
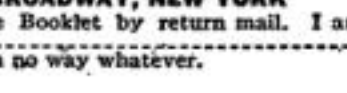
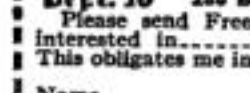
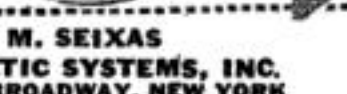
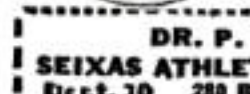
"PEP UP"—Let Me Help You
Picture No. 1 is a photo of myself. It shows my perfect body development. I don't just develop you so that you can show off. I pep you up, so that you are better able to do your daily work. I don't try to make you do something you don't like. I let you pick the exercise or sport you like best—whether it be body development, boxing, golf, running, swimming, baseball or any of the fifty other sports. I tell you how to become perfect in the sport of your own choice. When you get fun out of something, you surely get all of the real exercise, body development and limbering up anyone needs. I actually guarantee to make you expert in the sport you select. You will find several sports pictured here, but there are only a few of the many I can help you in.

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POPULAR SCIENCE MONTHLY

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I Teach By Mail

I can make a good penman of you at your home during spare time, no matter where you live or how poorly you now write. My simplified system has shown thousands the way to good penmanship during the past twenty-five years—it CAN and WILL do the same for YOU—

"My beautifully illustrated 32-page Book
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It contains many beautiful specimens of penmanship showing what others have accomplished by the Tamblin System, with testimonials and general information about our course—(Your name elegantly written on a card if you enclose stamp for postage). Ladies taught as successfully as men. WRITE TODAY, address

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RADIO CATALOG

Crammed full of Biggest

100 Live Pages

Contains interesting explanation of marvelous benefits of Radio which you may enjoy—told in language anyone can understand. You should get it before buying.

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Everything you may need to build or equip any set. Satisfaction or your money back. Don't Delay! Send for it TODAY!

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Money Making Opportunities

AGENTS AND SALESMEN

MAKE \$100 weekly in spare time. Sell what the public wants—long distance radio receiving sets. Two sales weekly pays \$100 profit. No big investment, no canvassing. Sharpe of Colorado made \$955 in one month. Representatives wanted at once. This plan is sweeping the country—write today before your county is gone. Ozarka, 803 Washington Blvd., Chicago.

SELL the latest, quickest selling specialties ever known. Famous "Hahway" self-lighting pocket cigar lighters and gas lighters. Low prices. Easily demonstrated. Sell to dealers. Employ sub agents. Exclusive territory. Make over 100% profit. S. Bernhardt, 148 Chambers Street, New York.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

AGENTS: Three neckties boxed singly for \$1.00—Retail \$2.00. Cash with order. Maxwell, 401 Searle Bldg., Rochester, N. Y.

AGENTS Wanted—Something New—Fire fighter sells easily. Makes a spectacular demonstration; car owners, homes, factories, stores, practically buy on sight. Our men make \$10.00 to \$50.00 a day. If you wish to establish a business of your own with unlimited possibilities for making big money, write us today. Fyr-Fyter Co., 298 Fyr-Fyter Bldg., Dayton, Ohio.

AGENTS make \$100 a week placing advertising cigar lighters with glass front. Every dealer wants one. Average profit \$25. Write for free plan. Drake Mfg. Co., Dept. P., Milwaukee, Wis.

BRING Home the Bacon—selling Stuart's Stain Remover. Removes ink, iron rust, grass and fruit stains. Write for free samples and terms today. C. H. Stuart & Co., 5968 B'way, Newark, New York.

\$20 PROFIT daily selling needlebooks; cost 3c-5c each; sells 25c; value 50c. Three samples 25c. Catalogue Free. Needlebook Specialty Co., 661 Broadway, New York.

SELLS itself. \$1000.00 Home Protection Contract. \$40 to \$80 for live wires daily. Write Am. Nat'l Benefit Corporation, Peoria, Ill.

WANTED—To hear from good stock salesman; stock insured against loss; good commission. T. G. Sortor, St. Joseph, Mo.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

NEW office specialty. Minute demonstration, sure sale, 100% repeater. Odiorne, 117 South Fourth, Philadelphia.

SELL Pearl Necklaces. 500% profit. Everybody wants one. Easy to sell. Write for rock-bottom prices. Star Import Company, 63 Second Avenue, New York.

GET our free sample case toilet articles, perfumes and specialties. Wonderfully profitable. La Derma Co., Dept. F, St. Louis, Missouri.

AGENTS: Big profits. Best and cheapest window letters made. Easily applied. Dime brings five samples. Particulars free. Stafrite Company, 1115 Second Avenue, New York.

AGENTS—\$75.00 Weekly Selling Nustile Guaranteed Hosiery. Your pay daily. You write orders, we deliver and collect. Special monthly bonus. Sample outfit furnished. Nustile Hosiery Mills, Dept. 400, Philadelphia, Penna.

HELP WANTED

EARN Money Weekly, spare time, home, addressing, mailing, music, circulars. Send 10c for music, information. New England Music Co., 118 Asylum St., Dept. B-6, Hartford, Conn.

MONEY! Silvering Mirrors, Auto Lights, Radiators, tableware. Methods Free. Write Sprinkle, Plater, 98, Marion, Indiana.

SILVERING Mirrors, French plate. Easily learned; immense profits. Plans free. Wear Mirror Works, Excelsior Springs, Mo.

OUR genuine gold window sign letters are an excellent money-making proposition for handy men. Slann Sign System, East Bethune Avenue, Detroit, Michigan.

MR. BRUSH SALESMAN: Old established New York Brush Manufacturers require the service of men in all territories to sell their extensive line of Sanitary Twisted in Wire Brushes. We pay larger commission than any other Brush House in the country. Write immediately for our proposition. Wire Grip Sanitary Brush Corp., 15 Mercer St., New York.

ARE you old at forty? See our advertisement on page 156 of this issue. The Electro Thermal Company, 4040 Main St., Steubenville, Ohio.

EMPLOYMENT in South America. We furnish classified addresses of 388 employers in Peru, Bolivia and Argentina for \$1. South America Information Bureau, Portland, Ore.

EARN \$1.20 an hour cutting blanks at home; spare time. Men only. Send addressed reply envelope. Good-year Sm., 147 W. 23rd St., New York.

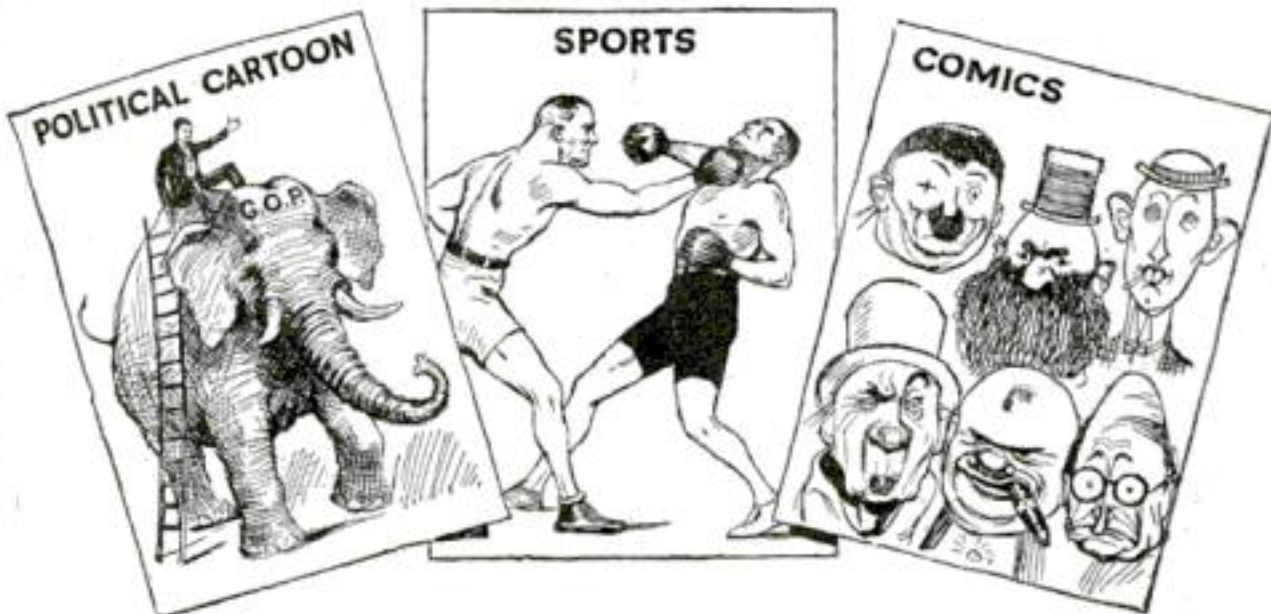
WANTED—Representatives in every factory in the United States. Popular Science Monthly, 250 Fourth Ave., New York.

MEN to Build Radio Sets for me in spare time. Leon Lambert, 555-D Kaufman Bldg., Wichita, Kansas.

WANTED Men and Women to represent Detective Agencies, in the United States and Europe. Enclose stamped, addressed envelope for particulars. This is not a school. Operators Information Bureau, P. O. Box 1861, Dept. 5, St. Petersburg, Fla.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

More Money Making Opportunities on pages 10 to 29



Thousands Can Draw CARTOONS Who Have Never Even Tried

Cartoonists earn from \$60 to far over \$300 a week. Why tie yourself to work that is drudgery when through a remarkable new method you can easily learn at home in spare time to draw cartoons that SELL?

THOUSANDS of men today are working at routine, uninteresting jobs who could be successful cartoonists. Many are earning pitiful salaries who could make wonderful salaries in cartooning. Briggs, Fox, Fisher, Goldberg and other leading cartoonists are credited with earning *more than the President*. Yet a few years ago many of our most successful cartoonists never dreamed they could draw a good cartoon!

The World's Easiest, Pleasantest and Best Paying Profession

Just watch a cartoonist work. A few little lines—a couple of simple curves—a splash of black here and there—and then you see a splendid cartoon before you. With a few strokes of his pen, he has taken some little incident of his day's experience—some humorous or sad scene he has witnessed—and produced a cartoon which tells the entire story to thousands of newspaper readers.

New Easy Way to Learn Cartooning

This fascinating ability to draw cartoons can now easily be *yours*—this ability which can mean so much real pleasure and profit to you. Through a wonderful new method you receive right at home through the mail a complete training in cartoon making, and *personal corrections on all of your work from*

one of America's most prominent cartoonists! With his help you can, in an *amazingly short time*, learn to draw the comic strips, humorous, political, and animated cartoons which are in such big demand.

Learn More About Cartooning Send for FREE BOOK

Never have cartoons been so popular. Millions of dollars were spent last year on cartoons of all kinds—and every week newspapers increase the amount of cartoons used. Get full details on the amazing opportunities in this fast growing field of Cartooning and full information on this remarkable home-study method. Mail coupon for FREE BOOKLET today.

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Please send me without obligation, your illustrated FREE BOOKLET on Cartooning.

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(Write name Plainly)

Address.....

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If under 16 years, please state age.....

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Become a big-pay man in the greatest industry of all time. Quickly, easily and right at home, you can fit yourself for highest salary positions, or you can cash in on your spare time. The call is urgent for mechanics, operators, designers, inspectors. Unlimited, fascinating opportunities on land or sea.

I WILL TRAIN YOU AT HOME TO BE A RADIO EXPERT

Under my practical, easy to understand, instruction—you qualify in an amazingly short time. No previous experience is necessary. Every branch of radio becomes an open book to you. You learn how to design, construct, operate, repair, maintain and sell all forms of Radio apparatus. My methods are the latest and most modern in existence.

FREE Wonderful home construction tube receiving set of the latest design. **Write Today "Radio Facts" FREE**

A. G. Mohaupt, Radio Engineer, RADIO ASSOCIATION OF AMERICA, Dept. 412, 4513 Ravenswood Ave., CHICAGO

\$90 Drafting Course FREE

There is such an urgent demand for practical, trained Draftsmen that I am making this special offer to deserving, ambitious men. I will teach you to become a Draftsman and Designer until you are drawing a salary of \$250.00 a month.

\$300 a Month Salary— \$450 on the Side At Home

That's the kind of money my drafting students make. Read what this one says:



"As a beginner I am doing fine. Am earning a salary of \$300 per month, besides I made over \$450 at home the last two months, drawing plans for private parties. The practical drafting training you gave me by mail put me where I am in less than six months' study. Thank you for all your personal interest and help you gave me so far." (Signed) J. B. (Name and address upon request.)

Write and I'll tell you how I make you a big-money-earning draftsman in a few months!

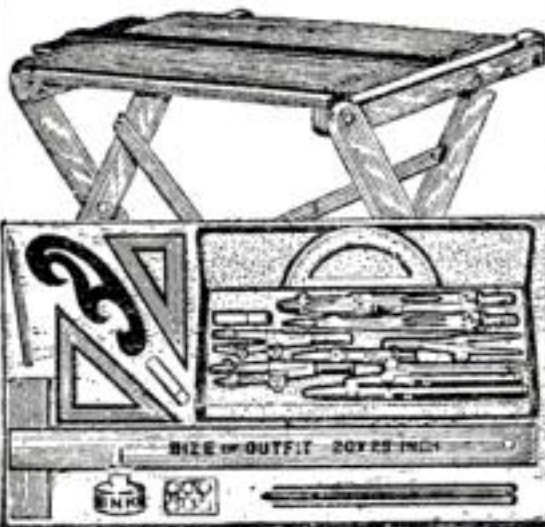
I Guarantee

To train you until you are placed in a position paying up to \$250 and \$300 a month.

I give you personal training at home by mail until you are actually placed in a position paying up to \$250 and \$300 a month. Six thousand draftsmen wanted every month.

FREE — Drafting Outfit Drawing Table

I give you a whole set of drafting tools and a drafting table the minute you become my student. Every tool you need. All you require to build your success in draftsmanship.



Mail Coupon

at once for my great book—"Successful Draftsmanship." All about the marvelous opportunities ahead. Great salaries and possibilities. Send the coupon for free book TODAY!

CHIEF DRAFTSMAN DOBE
1951 Lawrence Ave., Div. 13-69 Chicago
Without any obligation to me please mail your book, "Successful Draftsmanship," and full particulars of your liberal "Personal Instruction" offer to a few students. It is understood I am obligated in no way whatever.

Name..... Age.....
Address.....

"That Musical Pal of Mine"



Come On Boys— Let's Hear You Play!

There's nothing like good music for happiness; and there's nothing like a Hohner for good music. Millions of happy boys and girls are now playing Hohner Harmonicas for entertainment, popularity and education.

Anyone can quickly learn to play a Hohner with the aid of the Free Instruction Book. Get a Hohner Harmonica today—50c up—and ask for the free book. If your dealer is out of copies, write M. Hohner, Inc., Dept. 182, New York City.

If you want a musical treat ask to hear Victor Record 19421, by Borrah Minevitch.

HOHNER HARMONICAS

BIG NOVELTY BARGAIN! 10 Cts.

THROW YOUR VOICE

Into a trunk, under the bed or anywhere. Lots of fun fooling the Teacher, Policeman or Friends. Barrels of Fun.

THE VENTRILO

a little instrument, fits in the mouth out of sight, used with above for Bird (alls, etc. Sent with full instructions; anyone can use it, NEVER FAILS. Also a 32 PAGE BOOK ON VENTRILOQUISM. Formula for Secret Writing, 12 Money Making Secrets and the marvelous NOVELTY X-RAY WONDER

With it you can apparently see the bones in your fingers, lead in pencil, etc; lots of fun with this outfit. Also 10 Big Magic Tricks Free with every order. All the above Novelties by prepaid mail for 10¢

VENTRILO COMPANY
Dept. 7-9 Norwalk, Conn.
LARGEST and OLDEST Mail Order House in Connecticut.

Stop Using a Truss



Reduced Fac-Simile Gold Medal

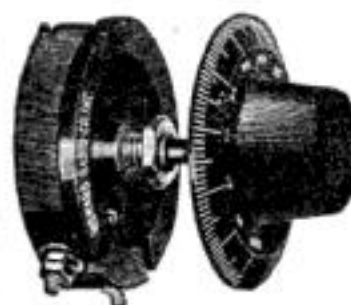
STUART'S PLAPAO-PADS are different from the truss, being mechanico-chemical applicators made self-adhesive purposely to hold the distended muscles securely in place. No straps, buckles or spring attached—cannot slip, so cannot chafe or press against the pubic bone. Thousands have successfully treated themselves at home without hindrance from work—most obstinate cases conquered. Soft as velvet—easy to apply—inexpensive. Awarded Gold Medal and Grand Prix. Process of recovery is natural, so afterwards no further use for trusses. We prove it by sending Trial of Plapao absolutely FREE. Write name on Coupon and send TODAY. **Plapao Co., 790 Stuart Bldg., St. Louis, Mo.**
Name.....
Address.....
Return mail will bring Free Trial Plapao



Reduced Fac-Simile Grand Prix



HOWARD STANDARD Rheostat



and 60 ohms. \$1.10 each.

Howard Standard Single hole Mounting Rheostats are guaranteed to give perfect filament control and uniform service. Workmanship and materials of highest quality. Carrying capacity 1.5 amperes. 6½, 25, 40

Howard Potentiometers are noted for their extremely close control of the potential in plate and grid circuits so necessary for selectivity. 200 and 400 ohm resistance. Price, 200 ohm, \$1.50—400 ohm, \$2.00.

HOWARD



"Sure Contact," the keynote of Howard tube sockets, afforded by new principle of contact on side of tube arms. Contact is permanent. Moulded base. Each \$1.25.

Every Howard part is Guaranteed Merchandise. Ask your Dealer.

Howard Radio Company
4248 N. Western Avenue, Chicago, Ill.

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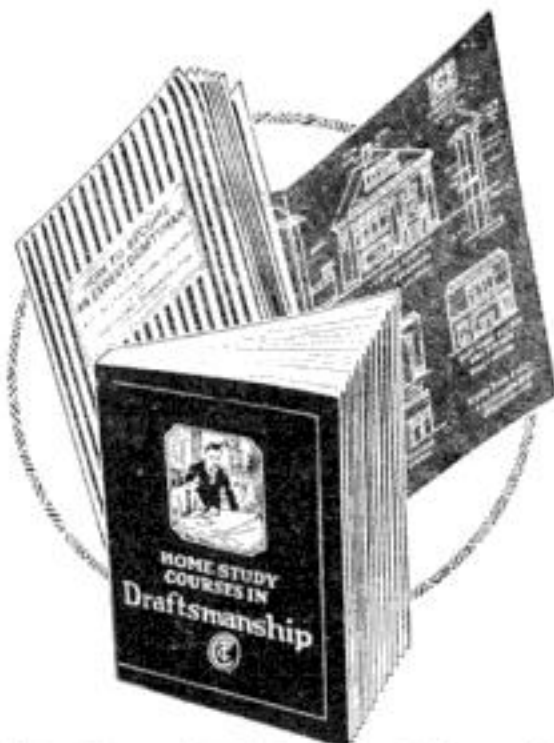
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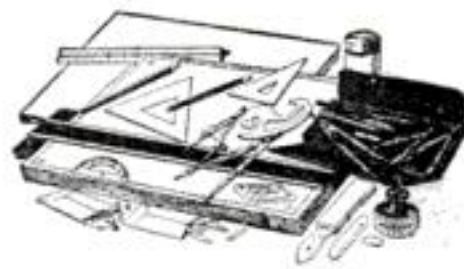
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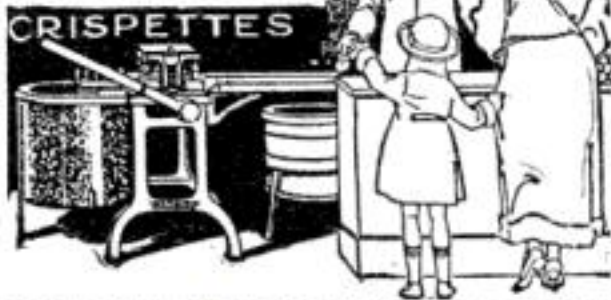
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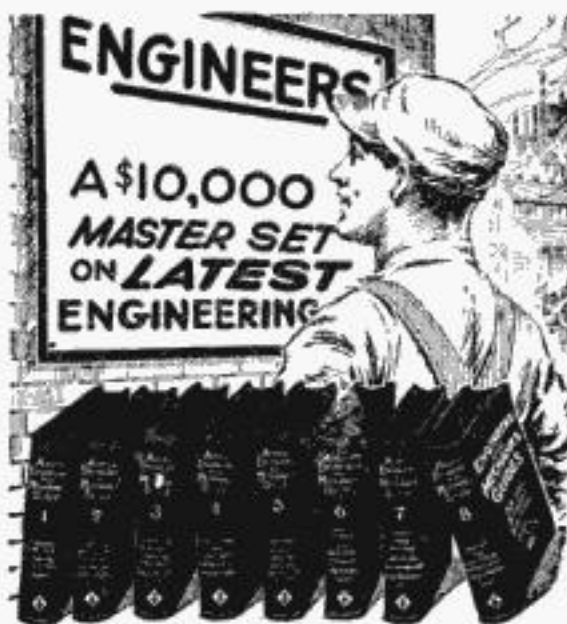
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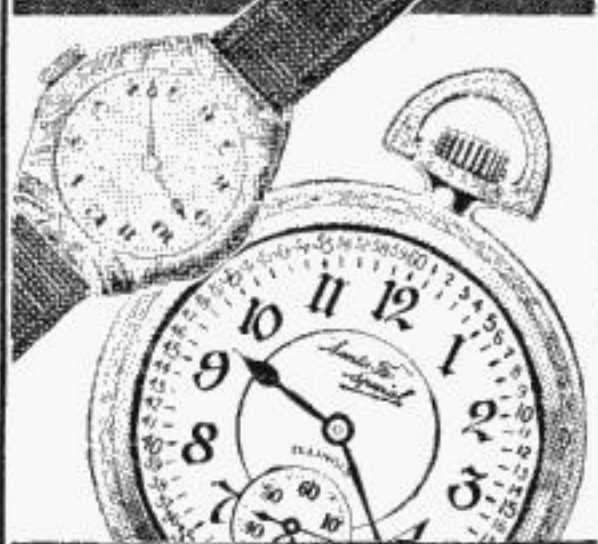
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2. Are the stars solid like the earth?.....
3. How was the earth formed?.....
4. Why is glass transparent?.....
5. How do we know that the earth is slowly shrinking?.....
6. What is an electric current?.....
7. How was petroleum formed?.....
8. Do electrons really move through wire when an electric current is flowing through it?.....
9. What physical changes in your body are produced by fear?.....
10. How do muscles exert power?.....
11. What are X-rays?.....
12. Can we see atoms with a microscope?.....
13. Why does heat expand things and cold contract them?.....
14. Why does the moon appear to change its shape from time to time?.....
15. What is the brain made of?.....
16. Why is it possible that the inside of the earth is growing hotter instead of colder?.....
17. Why is frost more likely on a clear night than on a cloudy one?.....
18. Does thinking use up the thinker's energy?.....
19. Which travels faster, electricity or light?.....
20. What simple test will distinguish wool from cotton?.....
21. What makes the noise of thunder?.....
22. Why would men ultimately suffocate if all the green plants were killed?.....
23. Does the boiling of water remove the impurities in it?.....
24. How do the living cells of the body get the energy with which to do their work?.....
25. How is the speed of light measured?.....

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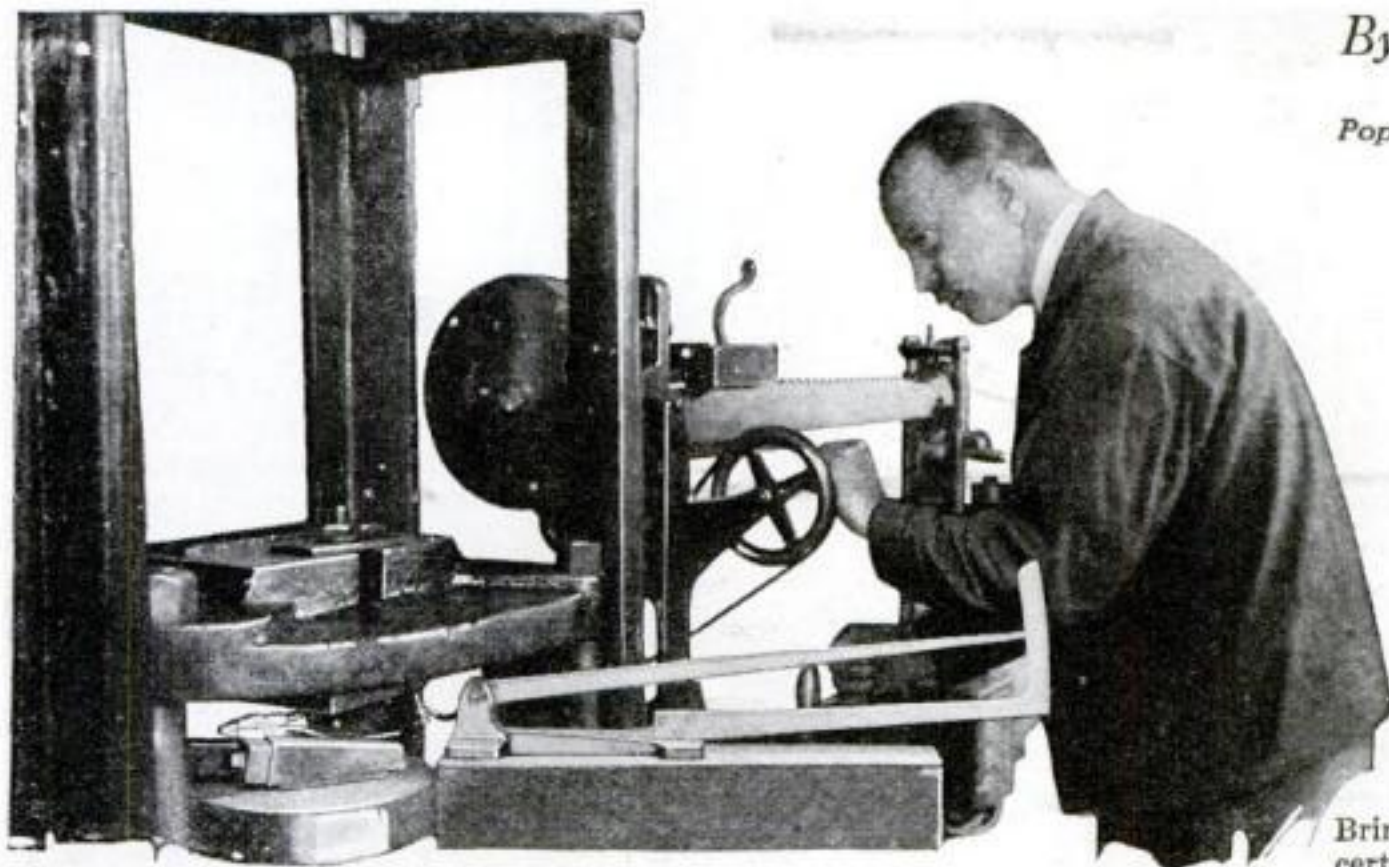
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Pliers Tested beyond Human Strength

By Collins P. Bliss, M.A.

Director of the
Popular Science Institute of Standards



The handles of the pliers (visible in the lower left-hand corner of the illustration) are being squeezed together by a force far beyond that which could be exerted by an exceptionally strong man—even if he got the pliers on the ground under his knee and brought the whole weight of his body into play. The crushing head of the compression machine can exert a pressure of 200,000 pounds which is recorded on the compression indicator shown at the right of cut

PLIERS are intended to be used as pliers. Many people ignore this fact and unreasonably expect them to substitute for hammers, crowbars, etc., as the occasion demands.

It is because such misuse is so common that plier manufacturers are compelled to allow a "margin of safety" in making such products, and the Institute of Standards has been obliged to devise laboratory tests that will bring out the characteristics of plier manufacturing best suited to meet abuse as well as to give true service.

The accompanying illustration shows the test used to determine the following three points:

1. The strength of the joints.
2. The strength and stiffness of the handles.
3. The toughness of the knife portion.

The latter test is, of course, employed only in the case of side-cutting pliers.

The crushing head of the compression machine shown (which is capable of exerting a pressure of 200,000 pounds, if necessary) travels down, squeezing the handles of the pliers together. This produces a turning movement on the hinge, forces the knife edges together, so that if the steel is too hard and brittle, they will crack; and it also produces a cross bending of the handles. This force is exerted until the handles have been squeezed together so that they are one-half inch closer at the extreme ends than when put in the testing machine.

This half inch is accurately measured with calipers and the pressure then relieved. The handles should return without any permanent set to their original position. If, to any appreciable extent, they do not, the pliers are re-

jected by the Institute of Standards.

Tests made at the Institute of Standards laboratories on some six-inch pliers have proved their ability to stand loads of nearly 500 pounds with only one-sixteenth-inch permanent set. This is far beyond any load that could be exerted by even an exceptionally strong man. Pliers so tested have kept their cutting edges true and the hinges have worked perfectly, which point is proved by opening and closing when holding one handle with the thumb and three fingers of one hand while operating the other handle with the little finger.

The toughness of the steel from which pliers are made is an important item to determine and this is ascertained in the

Brinell test. This is the same test a certain well known automobile manufacturer is now making on all parts of his car demanding great resisting qualities. The Brinell test is made by forcing a hardened steel ball into the tool under test. The depth of the indentation made by the ball is a measure of the hardness and toughness of the steel used.

Besides the compression machine tests, the cutting edges of pliers are subjected to a repeated usage test in cutting a number of wire nails of sizes corresponding to the grade of pliers tested, which is determined by claims made by the manufacturer as well as by the size or number.

In testing pliers advertised in POPULAR SCIENCE MONTHLY, the Institute secures representative products from a given line of manufacture. Sometimes in the delicate process of hardening steel, brittleness is caused by over-hardening. For this reason it is impossible for a manufacturer to avoid an occasional pair of pliers proving defective—but practically all are willing to make replacements under such conditions—and if they do not, the Popular Science Institute of Standards will.

It is obviously impractical for even as completely organized a bureau as the Institute of Standards to test all products listed in tool or radio catalogues advertised in our columns. Only tool and radio products specifically advertised in POPULAR SCIENCE MONTHLY are tested and approved by the Institute.

Send for List of Approved Products

POPULAR SCIENCE MONTHLY will be glad to furnish a list of Radio and Tool Manufacturers whose products have been approved by THE INSTITUTE.

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The above seal on an advertisement indicates that the products referred to have been approved after test by the Popular Science Institute of Standards.

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The Real Marvel of the ZR-3

An amazing story of duralumin, wonder-metal of aviation, that has made our big airships possible—With two fingers you can lift a girder of it strong enough to hold six men

By Lieut.-Comm. Fitzhugh Green, U.S.N.

NEWSPAPERS have devoted considerable space in the last few weeks to the exploits of the ZR-3, the largest dirigible to attempt a transatlantic flight. Tales of the tests and the flights of the big airship have been told and retold, but the story of the real miracle of the ZR-3, the *Shenandoah*, and other dirigibles is new to most folks. That is the story of duralumin, the marvel metal of the twentieth century—the metal invented especially for airships.

It is a remarkable partnership, this between the airship and duralumin. If it were not for the airship, duralumin probably would not have been formulated; if it were not for duralumin, there would be no transatlantic or cross-continent flights by dirigibles. The airship requires strength and lightness for its ribs and hull. Wood, while light, isn't strong enough. It won't stand the stress. Steel is strong enough, but too heavy. Duralumin is stronger than wood and much lighter than steel, in fact, about one-third the weight of the latter. So light and so strong is it that you can pick up with two fingers a girder of it that will support six men.

Duralumin is an alloy of copper, manganese and magnesium, with about 94 per cent of aluminum. In "strength-weight" efficiency, that is, in strength and lightness, it is 17 per cent greater than a good alloy steel and nearly three times better than mild steel or half hard aluminum. It was first made by Alfred Wilm in Germany in the development of Zeppelin airships, but is now being made in England and the United States.

Engineers talk among themselves of a Duralumin Age. They speak of vast quantities of fuel saved by lighter engines, trains and motors; of buildings dizzily high; of mechanical wizardry in manu-

facture; of a world unshackled from ponderous iron and steel. At this moment a large American corporation is seeking permission from the government to use

the power at Muscle Shoals to manufacture this metal for railroad uses.

That the thoughts of these engineers are not mere figments of imagination is proved by the visible evidence of the marvelous qualities of the metal in the extraordinary performances of the ZR-3 and the *Shenandoah*, as well as the tests of the F4-C, the Navy's first all-metal airplane, constructed entirely of duralumin.

THE principle of assemblage of duralumin girders in our great airships is exactly that which goes into the construction of a battleship. Every element not only supports its own quota of local weight, but contributes directly or indirectly to every other element in the whole ship. Thus we have a unified structure that, as the *Shenandoah* amply proved, can withstand the buffets of a hurricane.

Statistics of one of the new duralumin-framed air mammoths are illuminating. Take the ZR-3. Figures for her gas capacity reached 2,500,000 cubic feet. A ship of a size holding the immense volume of 10,000,000 cubic feet is contemplated. The latter will no doubt be the standard commercial liner of the

very near future.

Five 400-horsepower motors give a speed of 75 miles an hour to the ZR-3. A load of nearly 100,000 pounds can be lifted. This means at least 20 passengers besides crew and personal baggage. Something like 12 tons of profit-paying express can be added.

LET us translate this into terms of the competitive side of air transport as compared with transcontinental railroad service. At a fare of \$200 a passenger, and considering 72 hours as the coast-to-coast schedule, a company operating five ships ought to clear expenses on this side



One of the duralumin fuel tanks of the dirigible ZR-3. It is so light that a boy carries it easily on one shoulder. A steel tank of the same size would weigh three times as much.

of the business alone. That leaves the express profits to pay unusually large dividends on invested capital. And with the extreme safety of helium gas, as well as the rapidly increasing ruggedness of both frame and fabric, the "overhead" will be small.

These conclusions are by no means off-hand speculation. They are flinty facts already arrived at by a group of longheaded American business men who recently have organized to start an airways corporation just the moment that our navy's experiments put the official stamp of experts on their plans.

THERE aren't any hidden gun mounts on our liners of the air. Indeed, it can be said that they carry no special paraphernalia for tactical operation with a water- or air-borne fleet. Even that spartan austerity of trimmings so dear to the heart of the soldier and sailor at work, is spoiled by the luxury that went into the design of the ZR-3. A colossal sister ship nearly three times as big, already being discussed, will be even more palatial in her fittings. Soft berths, not bunks; white kitchens, not galleys; plush chairs and lounges rather than stools and benches, are some of the items that confronted the eye.

See how the score of duralumin mounts: Airship size no longer limited; mail and passenger service revived throughout the world, particularly at sea, where no water-borne vessel can compete with her rival in the air; health and comfort of travelers improved. All traceable to duralumin.

THERE is another aspect of airship travel—as distinct from airplanes—that is rarely noted. That is the unsurpassed safety of the duralumin-built dirigible.

No doubt some readers will smile at the suggestion. The fearlessness of the men who prepared the ZR-3 for her Atlantic voyage was well advertised. And justly so, too. For acute interest lay in the perils she faced that were unavoidable in her particular case. The North Atlantic is never entirely free from storms in the autumn. Moreover, while her diameter was greater than either that of the *Shenandoah* or the ill-fated R-32, engineers are

not yet wholly sure what dimensions are safest. The R-32 was lost and the *Shenandoah* and R-34 suffered much from the wrenching blows of high winds and from the violent bending forces induced by sharp course changes.

Then there were the specific disasters that make us shudder to recall them. France's reparation Zeppelin, the *Dix-*

tolerate fire in its vicinity; it is a fire extinguisher.

In my opinion duralumin is the most important single factor in bringing about the triumph of commercial airships, but there are other points in my conviction that they have come to stay. One is the anchorage now afforded by the mooring masts, which can hold and protect the largest dirigible in any kind of weather and offer safe haven to the air-liners in winds that ordinarily would keep them out of hangars. In addition to the safety element, the cost of a mooring mast—\$30,000, as against \$500,000 for a hangar—is a big argument for the operation of air-liners from a commercial viewpoint.

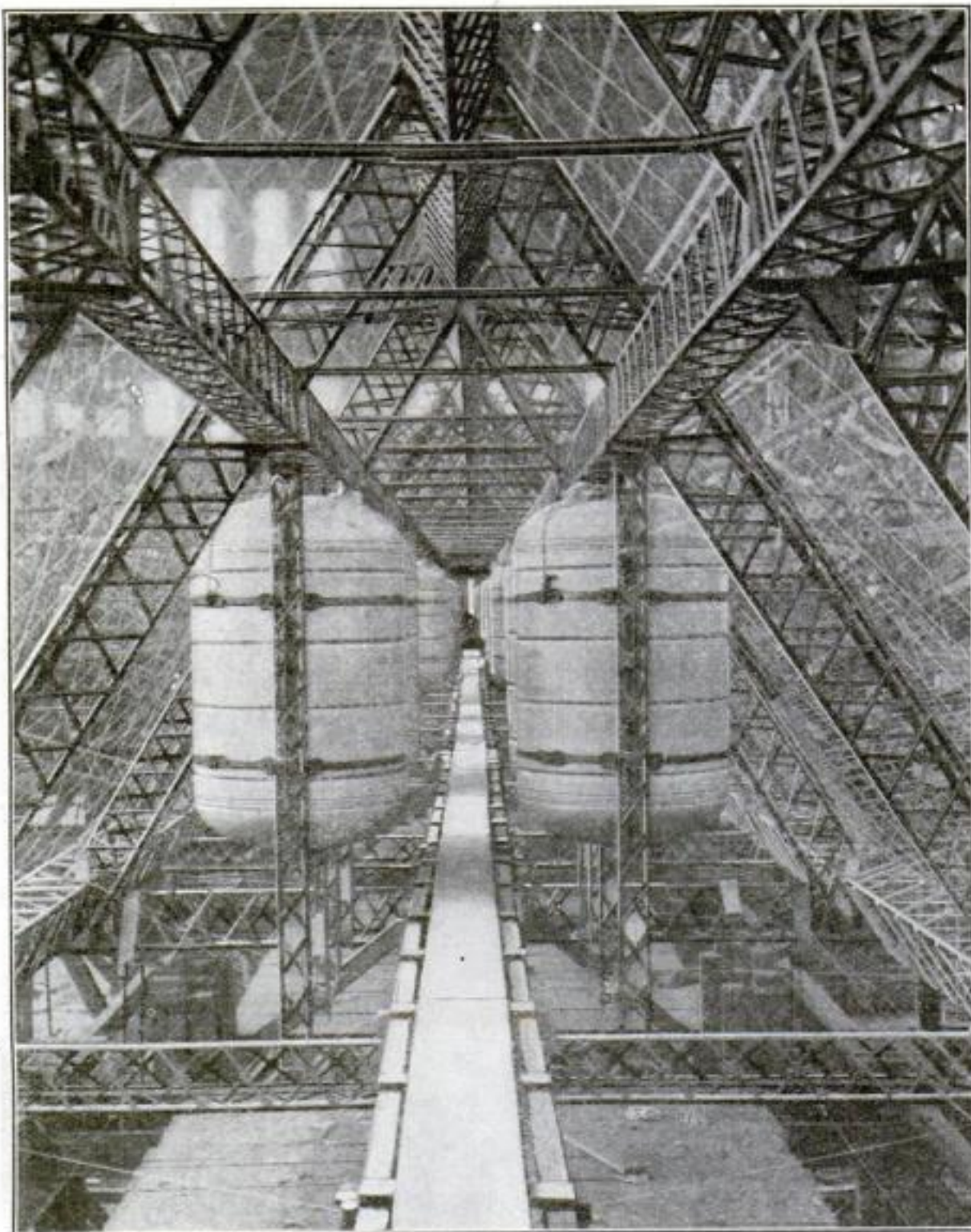
BUT mooring masts would have been of no use had not the dirigible been rugged enough to withstand the wind and rain. Nor would helium have stood for great progress over hydrogen had not its frail goldbeater's skin containers been housed in a structure almost incalculably staunch. Both the ruggedness and the staunchness were wanting before the day of duralumin.

Another unexcelled safety feature that distinguishes the air cruiser that has the light duralumin framework is that she is virtually *unsinkable*. She has 20—she may have 50—small balloons inside her metal hull. Each of these balloons is filled with gas and is independent of all the others. Each constitutes a lifting unit. Each can form an *aerial raft* in case of shipwreck. Each can be controlled by valv-

ing so that survivors clinging to it can drift landward safely. Each is individually inspected, tested, filled, and lashed in place before the journey.

Secretly all of us would like to fly, but most of us fear the dreadful roaring of the airplane's motor; the dizzy swooping speed; the possible plunge to death in case of accident. That fear need come no more. Through the agency of the wonder-metal, duralumin, the aerial liner will be safer than our floating palaces of the sea.

In the early stages of commercial air-liners we shall compare them with the *Majestics* and *Leviathans* of the sea. They will be the fast, luxurious vehicles of the very rich. But not for long. Already it is estimated that a three-day service be-



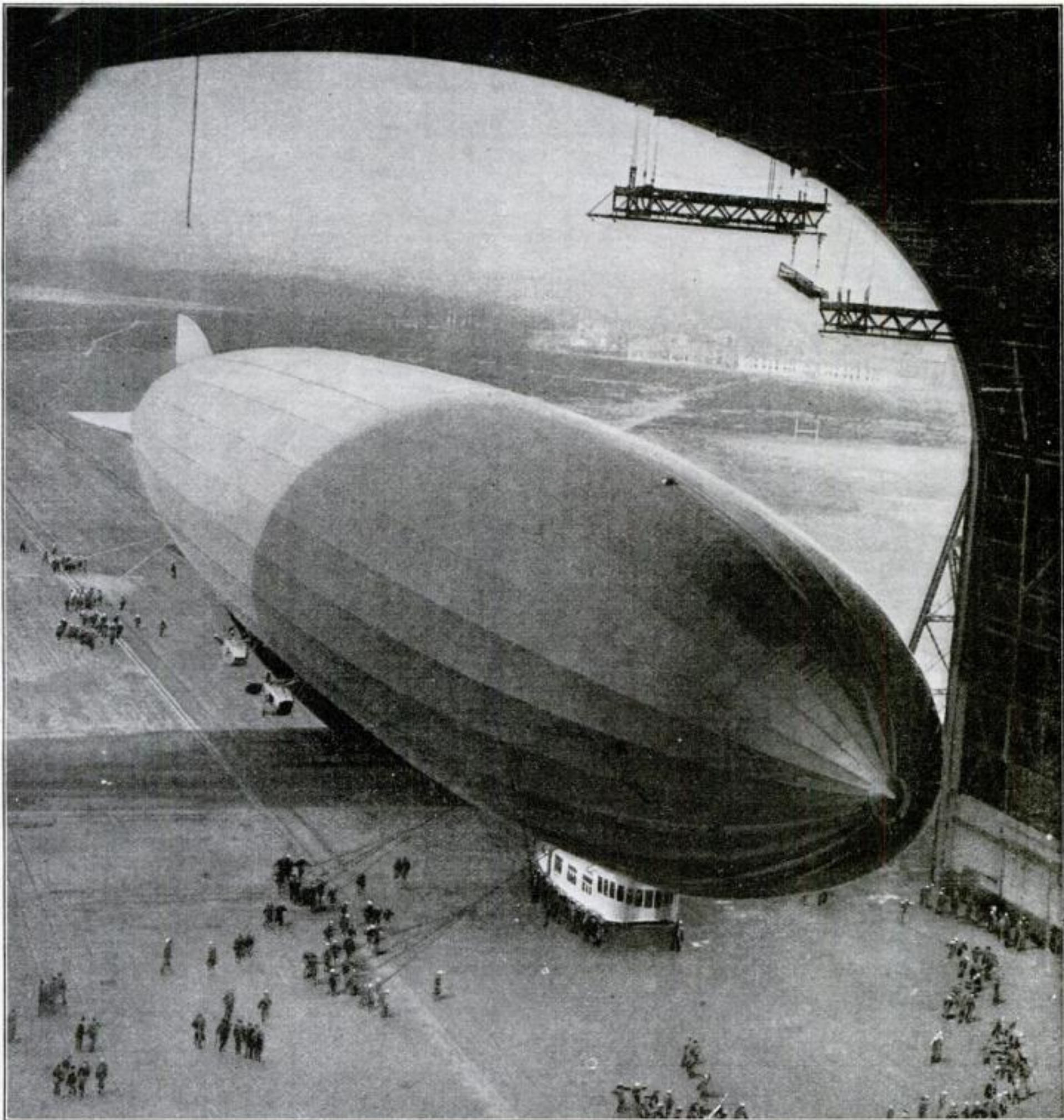
The Duralumin Skeleton of the ZR-3

The real miracle of the ZR-3—its vast skeleton of duralumin. Every single element of the framework supports not only its own local weight, but contributes directly or indirectly to every other element in the entire ship. The wonderful metal that goes into these girders

is so light and strong that you could pick up with two fingers a section of it that would support six men! The strength of duralumin, in proportion to its lightness, is 17 per cent greater than that of a good alloy steel. This photograph shows the fuel tanks in position

mude, originally built to bomb New York, was struck by lightning. The British R-32, built to be our ZR-2, broke in half and burnt up on her trials. The Italian *Roma*, built for our army, was ignited by high tension wires at Norfolk and cremated both herself and crew.

A LIST of horrors, to be sure; yet study of them reveals that the tragedy in each no longer would be possible. Neither the *Roma*, *Dixmude*, nor R-32 could have burned had they been inflated with helium. For the most energetic efforts of our best chemists have so far failed to set fire to this strangely inert gas. Not only that, but helium is a non-comburent; that is to say, it does not



The end of the greatest voyage in the history of air travel. This remarkable photograph shows Uncle Sam's newest passenger airship, the ZR-3, being warped into her hangar at Lakehurst, N. J., after completing her recent 5000-mile flight across the Atlantic from Friedrichshafen, Germany.

This great air-liner is 663.20 feet long and has gas capacity of 2,500,000 cubic feet. Driven by five 400-horsepower motors, she can attain a speed of 75 miles an hour. With her huge envelope supported by a skeleton of duralumin girders, she is built to withstand the buffets of a hurricane.

tween Europe and America of air-liners carrying 50 passengers and charging only what the steamships now charge, would be a financial success. A coast-to-coast service in the United States is said to promise financial return on mail and express alone.

Already, too, definite plans are being formulated for linking the nations of the world by commercial dirigibles—plans that include regular airship services between nations of Europe, America, Asia, and Africa. France intends to use the airship in developing her African colonies. Spain is contemplating weekly four-day flights between Seville and Buenos Aires. England is talking of an airship line to India and the Far East. For all such

projects, of course, dirigibles twice as large as the ZR-3 would be required.

There is sure to be almost an immediate demand for the "excursion air-liner." There is a passionate wanderlust in all of us that thirsts for a view of strange lands.

A horde of new interests will be aroused. Geography will take on a new significance. New mountain resorts, hitherto inaccessible, will be opened. A new and wider zest for such sciences as geology, meteorology, anthropology, physiography and glaciology will be born. Sports long neglected, perhaps not yet invented, will be entered into by millions. Mental and physical health of the whole human race will be decidedly improved.

Federal activity will be enlarged and improved. Special Red Cross dirigibles no doubt will be equipped for rescue work in floods and forest fires. Real estate business will take a new start. Larger and more beautiful suburbs will be planned and built. Aerial therapeutics for tuberculosis and other special disorders no doubt will be developed.

But let us not forget that the natural laws of aeronautics always have existed; that elements of such worth as helium surrounded Caesar. Not until the ingenuity of a chemist alive today added the final necessary touch was man master. That touch was *duralumin*, wonder metal of the age.

"Then the Lion

How it feels to face a savage beast of Alfred Klein, who has spent



work for the man who has killed more lions than any save one, Leslie Simpson of California. Mr. Klein has faced death 88 times, and each time won over a raging beast. Eighty-eight lions, roaring, crouching, springing! All of them he shot—more than a score of them just off the end of his rifle.

When young Alfred Klein left the quiet rooms of the American Museum of Natural History to go to Africa for specimens, naturally, he looked for some adventure. But at that time he never dreamed of all that was before him. For 14 years he remained in the jungle, far from civilization; but when he came back, he brought with him in a big box the high lights of his experiences during that time—20,000 feet of film, remarkable pictures of native hunts, murders, scenery, game; all the result of limitless patience, endurance and courage.

strutted around in the latest style of sports clothes, and went out once in a while to shoot a lion from a 'boma.' This is a kind of shelter made of brush, just big enough to conceal yourself and your gun. Outside this, you put a kill—the body of a zebra or cow, and then you wait for a lion to accept your bait.

"These 'boma' hunters were the ones who made most fun of the hounds. They said, 'Rainey thinks he's going to hunt rabbits.' I was to take Rainey out for lions.

"**N**OW, if any one thinks that hunting lions with dogs is easy, let him try it. Men at the hotel imagined that all we did was to follow the hounds until we were in sight of the lion, then pot him. So we took some of these men with us one day. They rode along with us over the thorn brush, falling into holes and getting scratched trying to keep up with the dogs, and then, at length, we came to the lion.

"There he was, crouched, with tail lashing. He let out one big roar. Our guests from the hotel gave one look, then turned their horses abruptly and departed. Shooting a lion from ambush is far different from shooting one

By G. B. Seybold

FOR eight hours we had followed a lion along a river bed, trying to get him in a place where we could take a good picture. It was in the heat of day—the stifling, killing heat of the African jungle. Our horses were tired, and the lion was tired. At last he went into a little clump of brush.

"I thought I saw him, and being impatient, picked up a big stone and threw it at him. I was right. I had seen the lion, but more important, the lion had seen me, and had seen me throw the stone. He didn't care about the rest of the party. He was after me. He sprang through the air, a roaring, hurtling mass. It was my chance to get a picture of a charging lion. I fixed my camera. I heard two shots and then the lion fell dead directly at my feet."

One such adventure would provide most of us with thrill enough to last a lifetime, yet it was only part of the day's

The first two years of his adventures in Africa he spent learning the language and the laws of the trail. After that Klein became a professional hunter and led expeditions of sportsmen from Europe and America. On most of these hunts he took moving pictures. The famous films that Paul Rainey, the late American multi-millionaire sportsman, brought back from Africa in 1912—the first moving pictures of wild animals ever taken on the East African coast—were part of his work.

Paul Rainey was indirectly the cause of many of the exciting adventures that Klein experienced, for he was the one who first introduced hounds into Africa for hunting lions.

"I shall never forget the time when Rainey appeared in Nairobi," said Klein, "with a pack of American hounds. You should have heard the ridicule of the crowd of sportsmen at the Norfolk Hotel there. Royalties who had come down to hunt had attracted a group of men who

facing you—one who knows you are his enemy and must be destroyed if he is to live."

Klein is a small, slender, wiry man, with taut muscles trained to give instant response. In the jungle brains are what count, not brawn. Many a time an extra 10 pounds is a great handicap. On a hunt one day Mr. Klein was thankful that he was not in the heavyweight class.

FOUR of us were hunting one morning at daybreak," he said. "Some lions had attacked a pack of hyenas and made away with them. When we found the stripped carcasses, the hounds gave tongue and followed. There were five couple of hounds in the pack to begin with, but they came to a place where the trails of the lions divided. The four lions had gone in three different directions. The pack separated, so there were dogs following each of the trails.

"When we got to the parting of the ways, we didn't know what to do. There

Alfred J. Klein, expert marksman and pioneer big-game hunter, with one of the 88 lions he killed during 14 years in the jungles of Africa

Sprang at Me!"

in the jungle—Thrilling adventures
14 years hunting wild animals

weren't enough dogs on any of the trails to really help in a showdown if the lion attacked. Finally, we decided to split into two pairs and follow two of the trails. Eric Shelley was my companion.

ON OUR trail the hounds ran the lion up a mountain. He went clear to the top, then down the other side, which was a regular precipice. We started sliding down on foot over the rocks. The rocks slipped and it was all we could do to keep on our feet and hang on to our guns.

"Partway downhill there was a ledge

A group of African natives, armed with strange weapons with which they hunt lions. This method is dangerous, and many natives lose their lives every year in close conflicts with the savage beasts

Mr. Klein's photograph below, showing a lion sunning himself in his lair, has been pronounced the most remarkable picture of a wild lion ever taken



about 10 feet square, covered with dense brush and in this the lion was hiding. We found there were only two hounds. They were practically useless, for two dogs wouldn't worry a lion more than a flea. They were exhausted and silent, so they didn't help us any in locating the lion, who was quiet, too. We knew that he was within a few feet of us. He could see us, and we couldn't see him. If he decided to leap, we had little chance.

"Well, he decided, and decided quickly. I was still sliding when out he charged, and he meant business. Shelley was a little back of me and he scrambled up the rocks. How he did it, I don't know

a start when I suddenly found I couldn't move. Something was holding me back firmly. The lion had got me, I thought. Then I saw it was my hunting knife, attached to my belt, which had caught in a limb. I gave a great wrench, the knife was pulled out of the sheath, and I went on climbing.

"I had my gun with me. Have you ever tried climbing a tree with a double-barreled gun? Finally, I got as high as I could and looked down at the lion tearing around below. I saw Shelley on his perch on the rock. The dogs were

yet. He was better than any monkey you ever saw.

"And I—I went up a tree. There are times for bravery, when you stand firmly on your feet and defy the world; but this was not one of them. That lion was too close for me even to lift my gun and aim.

"I made a world's record climbing that tree. I had just got

excited by this time and the lion left us. We let him depart in peace."

Klein's eyes twinkled. "His hide is one that I did not bring back with me to America."

One of the best pictures Klein took was of a lion being killed with spears by natives. This, he explained, was the result of days and weeks of work.

"THAT is one of the most difficult things to get," he said, "for you never know just where the lion will be. In these hunts each savage has four weapons—in his left hand a big shield, in his right a spear, and on his belt a thick club and a sword.

"The natives run the lion down on foot, then all jump at him at once, spearing him any place they can. I have tried again and again to get good pictures of this, but the lion rarely fights just where you think he will. He turns and charges just outside the range of the camera. Or, sometimes, he comes too close. Then you are thankful for the size of the camera in front of you."

Many have slandered the lion by asserting that he is not "King of Beasts," but

(Continued on page 157)



Another of Mr. Klein's extraordinary photographs, showing a wild lion attacking a zebra. It is said to be the only close-up picture of its kind ever obtained

Speedy New Motor-Hoop Amazes Italians

Policeman's Strange Invention Runs from Milan to Rome

By Giuseppe Gagliardi

SPECTATORS at the speedway before the National Stadium in Rome, Italy, gasped with amazement not long ago when they saw a huge wheel, driven by motorcycle engine, careening at high speed around the track like an overgrown toy hoop. Within the wheel, apparently unconcerned at the possibility of being precipitated in the mad whirl, they saw a driver, his hands gripping an ordinary automobile steering wheel, his feet resting on ordinary motorcycle pedals.

His body kept the wheel in perfect balance. At every turn he would lean to one side or the other. And when the spinning wheel finally slowed down and came to a stop, he simply rested both of his feet on the ground, then let down a standard to keep the wheel from toppling over!

The driver of this remarkable vehicle was Davide Gislighi, a motorcycle officer of Milan, Italy. Possessed with the idea that one wheel would be more efficient than two, he had perfected what more than one inventor before him had attempted unsuccessfully—a one-wheel cycle that actually would run!

IN RECENT years there has been a marked tendency to reduce the size and weight of motor vehicles and their parts. The light, speedy cycle-car is one example of this development. But this Italian inventor seems to have arrived at the irreducible minimum. He could hardly hope to travel on less than one wheel, and he has left just enough room in his odd car for the rider to sit and drive, leaving luxury or comfort, of course, out of consideration.

Only one tire to puncture, only one wheel to push out of the mud, a lessening of resistance—the owner of an automobile or motorcycle can think of many advantages possessed by a vehicle that can run on one wheel instead of two, three, or four.

The unicycle, which is called a "velo-

cita" by its designer, and also a "motor-mota," has two principal running parts—a large pneumatic tire and an inner hoop of steel. The inner circle carries the driving mechanism and the driver, while the

it, and the driver himself, are grouped in a small sector of the circle. On the outer circumference of the steel hoop are rollers, and these support the run of the tire. Thus the two concentric pieces, hoop and tire, are independent of each other as the wheel moves forward.

WHEN the machine is moving, the inner hoop is kept stable to a great extent by the weight of the engine and driver. But opposing this, there is a friction roller, driven by the vehicle's motor, which acts against the rim of the tire and revolves it. This force is more powerful than any retarding resistance.

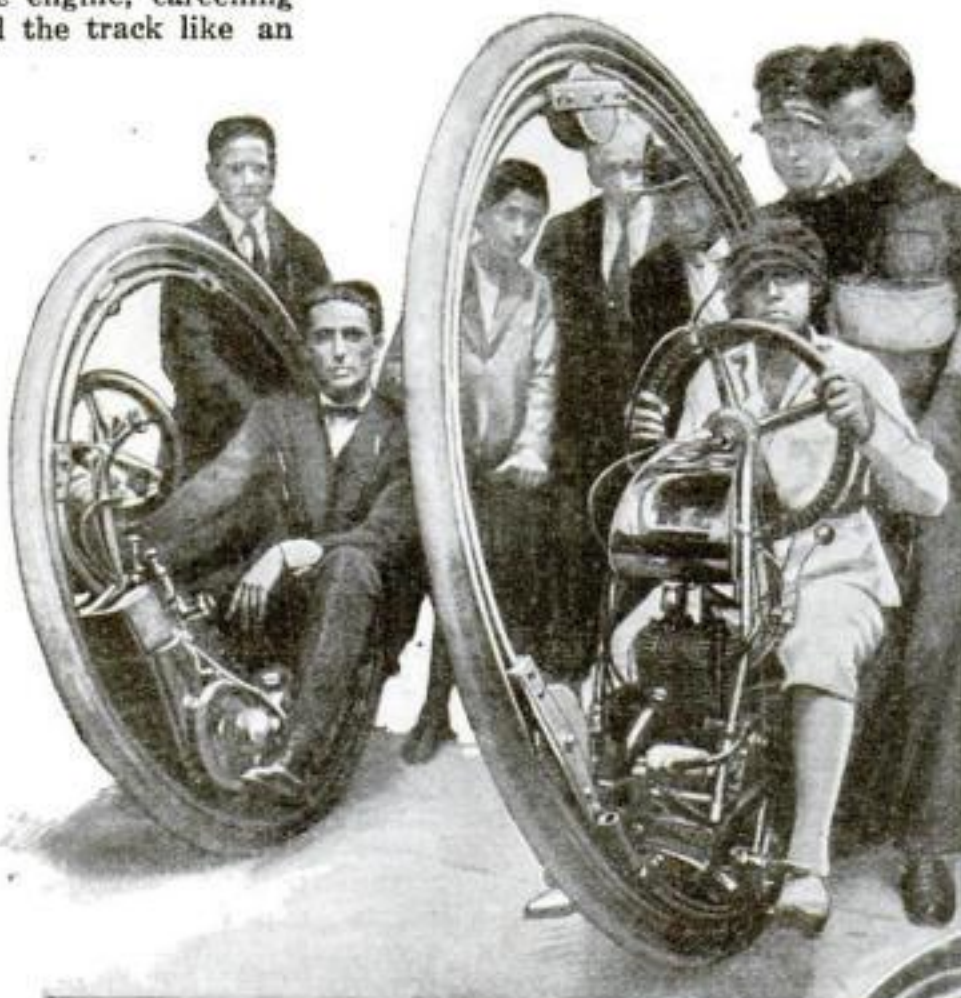
So it is that the driver does not turn with the wheel, but maintains his upright position. He balances the machine much as he would a motorcycle, and he regulates the direction to be taken by the vehicle by inclining his body to the right or left and by a steering-wheel similar to those on automobiles. To keep the wheel from falling when it is not in motion, there is a special stand that fits inside the circle and can be released.

The motor actually travels on an endless circular track furnished by the revolving of the wheel.

When the inventor completed his machine in a small workshop in Milan, the device was not considered seriously by

mechanics and engineers. They thought it simply a toy or novelty, incapable of being used as a practical method of conveyance. So Gislighi made a wager that he could travel in it at high speed from Milan to Rome and race in it before the stadium.

He won his wager and then gave several other satisfactory demonstrations that convinced spectators that what they saw was not a freak toy, but a vehicle that actually could be operated successfully. The inventor now is experimenting to increase the speed of the unicycle, whose possibilities for speed as well as everyday utility he believes are almost limitless.



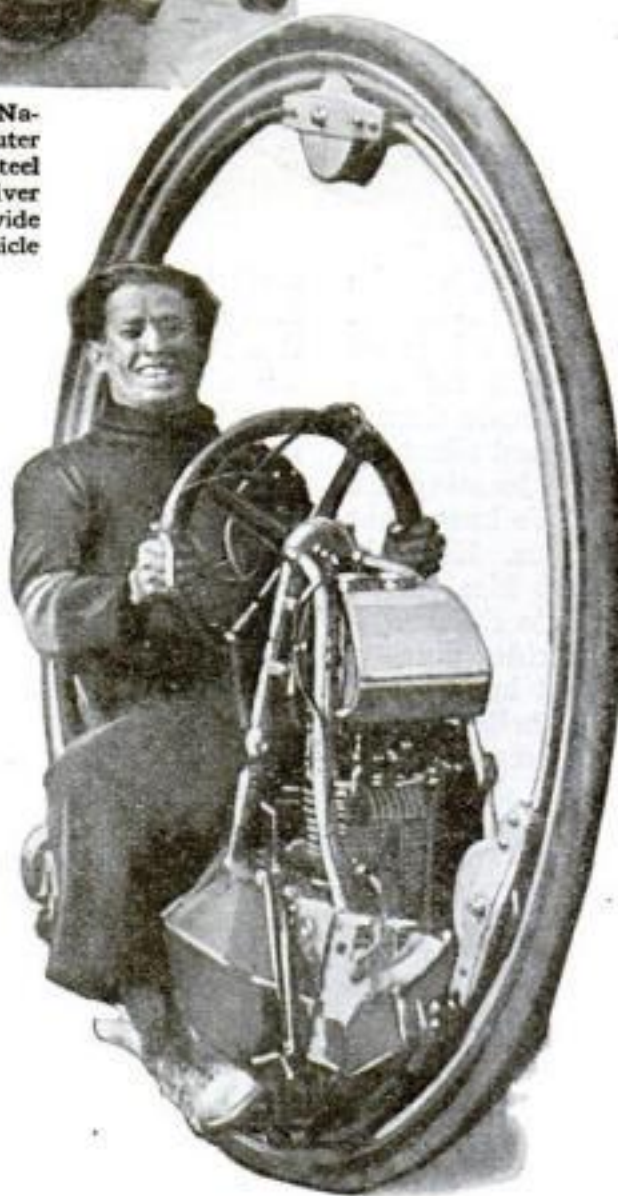
Two of the odd new motor-hoops before the National Stadium at Rome, Italy. Notice how the outer rim with its tire moves on rollers about the inner steel hoop, which is held stationary by the weight of driver and engine. At the right is the inventor, Davide Gislighi, enjoying a ride in his strange vehicle

tire moves around it. The diameter of the wheel varies according to the height of the driver, but usually it is about five feet. A short man has a smaller wheel than a tall man.

Since economy in size is a primary consideration, the wheel is always made just large enough to prevent the driver's head bumping against the circle.

The air-cooled motor that drives the wheel forward, and its accessories, are fixed rigidly to the inner steel hoop.

The motor, the driver's seat back of



Mud Torrent Ruins Farms

Mt. Shasta Glacier Melts, and Sweeps toward California Towns



A Niagara torrent of mud, on which boulders were tossed like twigs on a mountain stream, recently swept down Mt. Shasta, Calif., into the surrounding valley, ripping walls of canyons, leveling mighty trees, ruining acres of farm and timber lands, threatening the safety of lowland towns.

It was an occurrence unique in America. For the torrent was formed by the melting of Mt. Shasta glaciers. An extremely hot summer, an unprecedented drought, and little snow on the mountain's crown, shown below, contributed to the slide



Above is a remarkable view of the stream of mud flowing through a canyon from the slopes of Mt. Shasta, an extinct volcano 14,380 feet high, seen in the background. The mud, thick as newly mixed cement, was composed of glacial dust and snow melted by the summer sun



At night the surface of the mud river took on a thin crust. At left, workmen are seen digging out an auto whose driver was deceived by the crust's appearance

The channel of the river of mud is shown below. The stream was about three-fourths of a mile wide, several miles long, and from six to eight feet deep. Ancient trees which had withstood storms for 150 years were buried to a depth of 12 feet



McCloud and other towns within the circle on the above map felt the effect of the mud flood in crippled railway lines, ruined water supplies, and bewildered terror among their inhabitants



Toys that Have Helped Men to Great Success

Interesting stories of the boyhood of famous leaders and inventors—
How playthings affected the careers of the Wright Brothers,
John W. Davis, and Admiral Moffett—A noted manufacturer tells how to buy the right toys for your child

By Ferdinand Strauss

NOT long ago I read a story about Orville and Wilbur Wright; a sort of biography that included some interesting details about their childhood. Among other things, it told how the two little brothers in Ohio used to play with balloons after school hours.

Of course, every person has played with balloons at some time in his life. The light, gaily colored spheres are pretty, and there is a fascination in letting a gas-filled one go up and pulling it down again—a feeling of power because you can control it by so slight a motion of the finger.

But the Wright boys played with balloons more than their playmates. They experimented with different sizes and floated them at various heights, to watch how the wind blew them. In playing with them, they never dreamed that they were to be the men to introduce, through heavier-than-air planes, an entirely new method of transportation that would thrill the world.

I was impressed by this narrative, especially, I think, because as a manufacturer of toys, I have long been interested in the effect of playthings on a man's career. Again and again I find, in reading of the childhood of famous men, or in speaking with them, that they spent their play hours with toys that had some definite connection with their later occupations.

IF LINDENTHAL or Modjeski, the great bridge-builders of today, were to tell you of their childhood, I'll wager you would learn that as boys they spent at least 90 per cent of their time making toy bridges.

Look back at the boyhood of John W. Davis, who at this writing is a candidate for the Presidency. At the age of 10 years he was navigating toy boats on a brook and organizing the "East India Boating Company," perhaps in remembrance of the dashing hero of Elizabethan days of the same name, who had so many thrilling experiences on the seas. While marshaling his little boats into line, loading and unloading them, John Davis

was developing those qualities that he now demonstrates as a leader and organizer.

Or ask Rear-Admiral William A. Moffett, Chief of the Bureau of Aeronautics, U. S. N., what he did when a boy, and back comes the answer: "I was most interested in flying kites."

Carl E. Akeley, the inventor and big-

for construction is almost helpless. Carl Akeley is not, for as a boy he possessed a toolchest.

Another who used tools was Dr. George Ellery Hale of the Mount Wilson Observatory, one of the foremost astronomers, not only of America, but of the whole world. Among his favorite toys were model engines, yachts, and other machines that afforded opportunity for mechanical construction.

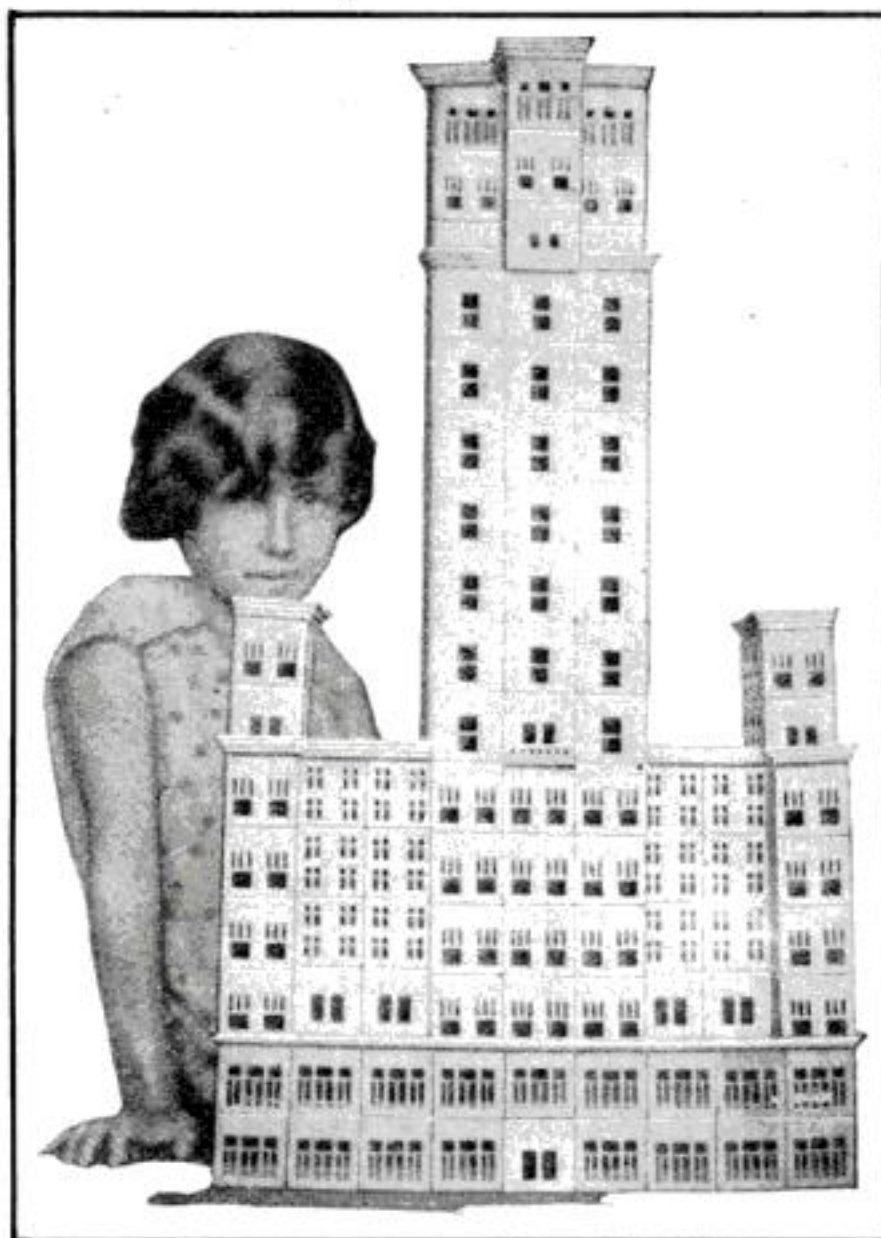
When he was 10 years old, his father gave him a toolchest, and this became the nucleus of a small workshop that he built eight years later. He had a lathe, a scroll saw, a microscope, a camera, a telescope, and other tools and apparatus with which he equipped a small laboratory. There he began to design simple physical and astronomical instruments. Doctor Hale still uses some of the "toys" of his boyhood.

ARE not these examples significant?

As a child, I was extremely interested in mechanical playthings. I can remember that I was never so happy as when I would pull my wagon around town packed full of the neighbor children. I was so much interested in toys that when I became a man, ready to choose my work, I couldn't give them up; so I started in the toy business.

The child who is interested in electrical toys will understand better throughout his lifetime everything he reads about electricity. The boy who spends his time with tools will not necessarily become a mechanic or carpenter, but he will, at least, develop into the "handy man" who is equal to any emergency about the house. Few realize the great importance of playthings in developing genius and craftsmanship.

Occasionally I have watched parents and fond relatives wandering about aimlessly, just before Christmas, in the toy departments of big stores. They finger this toy and that worriedly, and finally end by buying something—anything—at the counter that is least crowded.



"A toy is part of a child's education," says Mr. Strauss. "Why not give children something that will encourage them to think and develop their latent powers?" Above is a new type of educational toy designed to develop the natural ability of boys and girls in construction and architecture. It consists of numbers of standardized building parts, such as walls, flooring, doorways, roofs, and windows. These can be fitted in almost unlimited combinations and designs, from the simplest garage to a skyscraper

game hunter, spent his playtime as a boy with tools. The gift of a folding pocket foot-rule, he says, gave him a big thrill, and with his tools he made toys and useful articles for the house. In the heart of a jungle, hundreds of miles from any source of supplies, a man without ability



Ferdinand Strauss, a pioneer in the invention and manufacture of American mechanical toys, is 59 years old, yet not too old to be passionately fond of playing with his creations, "making the wheels go round." This passion for the creation of playthings—for himself and his companions—has been with him ever since his boyhood days in the little vineyard town of Gölheim, Bavaria. When he was 18 years old, and a university graduate, Strauss came to America. His first position was that of a sample boy for a concern that made and sold summer wearing apparel, and his

salary was three dollars a week. It was not long before the young man who liked to play with toys tired of this work. He left his position, went into business for himself, and popularized the harmonica. From that it was but a short step to the making of mechanical toys, and in this field he achieved his greatest success. This success he has built on the theory that the child is father to the man, and that the selection of toys for children to play with should be made with this idea in mind. The photograph shows him with some of the newest of his ingenious mechanical playthings

Such parents lose a great opportunity by neglecting a chance to help their children. A toy is part of a child's education. Just as educators choose textbooks, considering carefully the needs of the child, so should the parent choose toys. He should think it all out before ever going near a toy store.

Johnny is 10 years old. What sort of toy will help him most at his particular age? In what sort of thing is he most interested—mechanics, electricity, or something else? And what will amuse

him most? What will give him the best time? The boy is going to spend his play hours some way during the coming year. Why not give him something that will encourage him to think and develop his latent powers?

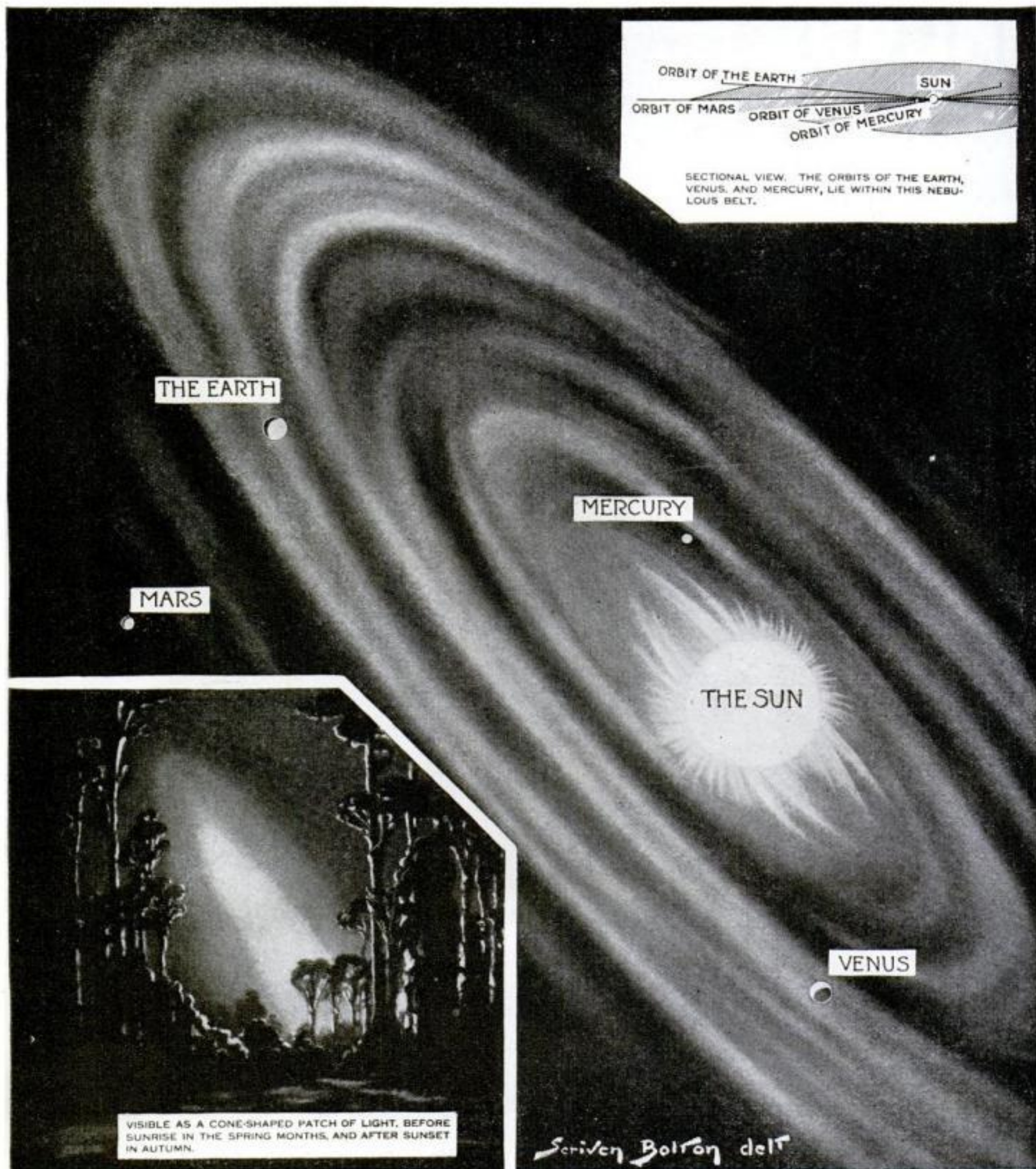
America makes toys that teach something, because it has advanced further in the field of child psychology than any other country in the world, and the psychologists have demonstrated the fact that children *learn while they play*.

America is the land of playing children.

There are 100 children who play in America to 25 in Europe. The result is that there is little individuality in the children in Europe. They are stiff, unassertive, and afraid of one another. Later on, they don't know how to work well together, because they haven't learned how to play together. Most foreigners who visit us remark the smartness of the American child.

You know how it was in Germany during the war—there were only a few

(Continued on page 163)



A 100-Million-Mile Belt around the Sun

Does It Affect the Weather Conditions on Earth?

By Scriven Bolton

UNUSUAL weather conditions in all parts of the world during the last few months, especially marked by a late spring and early autumn have given rise to the question whether our climate is affected by a vast 100-million-mile ring of matter observed about the sun.

This faint, cone-shaped belt of light stretching up from the western horizon

has been visible in clear skies before sunrise during the spring, and after sunset during the autumn. It is known to astronomers as the Zodiacal Light. They explain it by saying that the sun is circled by a huge flat ring of matter, somewhat like the rings of Saturn, and extending into space for more than 100 million miles, far beyond the Earth and its orbit, as shown above. Its position, as seen from the Earth, is always edgewise; hence its cone-

shaped appearance. The great ring is composed of a huge conglomeration of minute solid particles, or meteoric bodies, having rough surfaces, and shining by reflected sunlight. Like the Earth, each particle moves in its own elliptical orbit around the sun.

This ring of matter appears to offer no resistance to the movement of the Earth, Venus, and Mercury, whose orbits lie within its boundaries, or to that of comets.

How Typewriter Detectives Solve Baffling Mysteries

Every letter on your machine offers the expert a clue to your identity—Remarkable stories of a new science

By Fritz Blocki

EVERY day science is performing feats that overshadow those of the famous detectives of fiction. Take, for example, the seemingly impossible task of identifying a man by his typewriting—running down a machine-made clue. No doubt you read how this was done in a recent sensational murder case in Chicago, when typewriting experts were able to testify that certain letters that tended to establish a "motive," unquestionably had been written

phy (the photographing of documents), microscopy, photo-micrography, mathematics, and handwriting, are only a few of the scientific branches that the questioned-document expert uses in his daily work; for it should be understood that when the expert asserts that this letter or will is authentic and that one a forgery, he does not merely express an opinion. He must demonstrate the

Loren C. Horton, one of the country's foremost experts on "questioned documents," who has solved many a baffling crime mystery by running down typewriter-made clues. He is shown using an instrument for projecting light through paper to examine ink lines of hand-traced forgeries



on a typewriter that had been stolen by one of the suspects and had been recovered by the police from the bottom of a park lake.

That a criminal can be traced, captured, and convicted through a scrap of typed paper, which apparently is just like any other piece of typing in the world, almost challenges credence; yet to the expert on "questioned documents" such accomplishments are in the day's work.

To him a "slim clue" is not merely a figure of speech; he deals constantly with quantities that are infinitely small. To him a difference of possibly a hundredth of an inch in the length of the cross bars of two typed *t*'s carries a graphic, understandable message. Departures from the rules of punctuation reveal to the expert unmistakable peculiarities of the typist's methods. The difference in shading between two typewritten lines may establish as a forgery a document upon whose authenticity the disposition of thousands of dollars depends.

Loren C. Horton, of New York City, is one of the country's foremost exponents of this little understood science, for science indeed it is. Chemistry, documentogra-

phy (the photographing of documents), microscopy, photo-micrography, mathematics, and handwriting, are only a few of the scientific branches that the questioned-document expert uses in his daily work; for it should be understood that when the expert asserts that this letter or will is authentic and that one a forgery, he does not merely express an opinion. He must demonstrate the

truth of what he says so conclusively that his testimony will be admitted as evidence in a court of law and yet so simply that his processes will be understandable to those who are not scientists—judges, lawyers, and jurors. The story that Mr. Horton tells of his work is thrilling and dramatic—in its results at any rate, even though those results are achieved by meticulous care, tireless research, repeated experiment and minute analysis—the methods, in short, of the scientific laboratory.

THERE is nothing that suggests the detective in the personality of this man to whom each typewriter possesses characteristics as individual as the differences in height, coloring, features, and body contours that distinguish human beings. In appearance he is not unlike John W. Davis, and he speaks clearly and decisively with the precision of the man long used to scientific accuracy.

"Typewriters are no more exactly alike than are human beings," he told me. "All

normal people have two arms, two legs, and two eyes, yet no two people are exactly alike, no matter how closely they may seem to resemble each other. So it is with typewriters. These show their individuality, not by their appearance, perhaps, but by their written products, or their type equipment. These are as various as the persons who use the machines, though the writing may all look strikingly alike to a layman.

"The various styles of type on various makes of typewriters are not the same; no two sets of type made by different manufacturers are exactly alike in shape."

MR. HORTON took up two bits of typing I had brought with me. He glanced at them and quickly told me that they had been written on different typewriters, though he had never seen those slips of paper before. Then he had me examine them under a microscope, and by comparing only two letters, the *a* and the *s*, I quickly noted a marked difference between them. The concluding curl of the *a* on the lower right-hand corner curled upward in one letter, downward in the other. On the letter *s*, the vertical lines that form the finish at the top and bottom of the letter were straight in one specimen, decidedly curved in the other. These little lines are called "serifs."

"That gives you an idea of a few of the many points of differ-



The words below were typed on a machine that purposely had been thrown out of alignment to illustrate to the court how a machine could be manipulated to hide its individuality. This specimen helped expose a forgery on which millions of dollars depended. The illustration at the left shows how the E bar was bent to accomplish the misalignment of type

ence that may be found in typewriting," said Mr. Horton. "Besides these, there may be a difference in the curvature of the elliptical letters, such as *e*, *c*, or capital *G*, or the angles of *w*, *v*, and *y* may be sharp in one case, comparatively broad

in another. Other differences may be found in the length of the tail of the *y* or in the length of the cross bar of the *t*.

"A very slight difference in the length of this cross bar helped to expose a forged will in a case involving several hundred thousand dollars. A few years after a wealthy Chicago man died the manager of his wife's affairs produced an alleged will purporting to have been written four years after a will already probated.

"I photographically enlarged this document, taking a section at a time. The enlarged photographs and the will itself as seen under the microscope showed that the impressions of all letters had been very slightly penciled over, a task that must have taken hours. So carefully was the work done that it was almost impossible to detect the change with the unaided eye.

"ALSO, the type bars of the machine on which the 'will' was typed had been bent in a way that was most unlikely to have occurred from usage. The inference was that an attempt had been made to disguise the typewriter. However, the writer of the document could not change certain unmistakable characteristics, so I was able to name the make of typewriter used in preparing the alleged will.

"Years after the date of this 'will' the company had shortened the cross bars of its *t*'s. If the will were typed on a machine with short cross bars, it would disclose that the date was incorrect; hence, that the will was a forgery. So it was necessary to lengthen the cross bar on each *t* with a graphite pencil.

"One letter so doctored would have meant quick detection, but with all letters penciled, it was virtually impossible to prove that the *t*'s had been lengthened. There were so many suspicious points connected with this document,

however, that it was not admitted to probate.

"In another case a man who tried to alter a document with a machine of later date than that with which the original typing was done attempted to change the length of the cross bar on the *t* by grinding it down with an emery wheel. He succeeded, but only partly, for in doing the work he accidentally shaved the little curl

at the bottom of the letter. The odd appearance of the resultant letter aroused suspicion, and magnified photographs of the type showed plainly the marks of some abrasive.

"Typewriting is almost as personal as penmanship sometimes, due to certain peculiarities or mannerisms that the typist has developed. Such clues may be found in spacing, spelling, or punctuation.

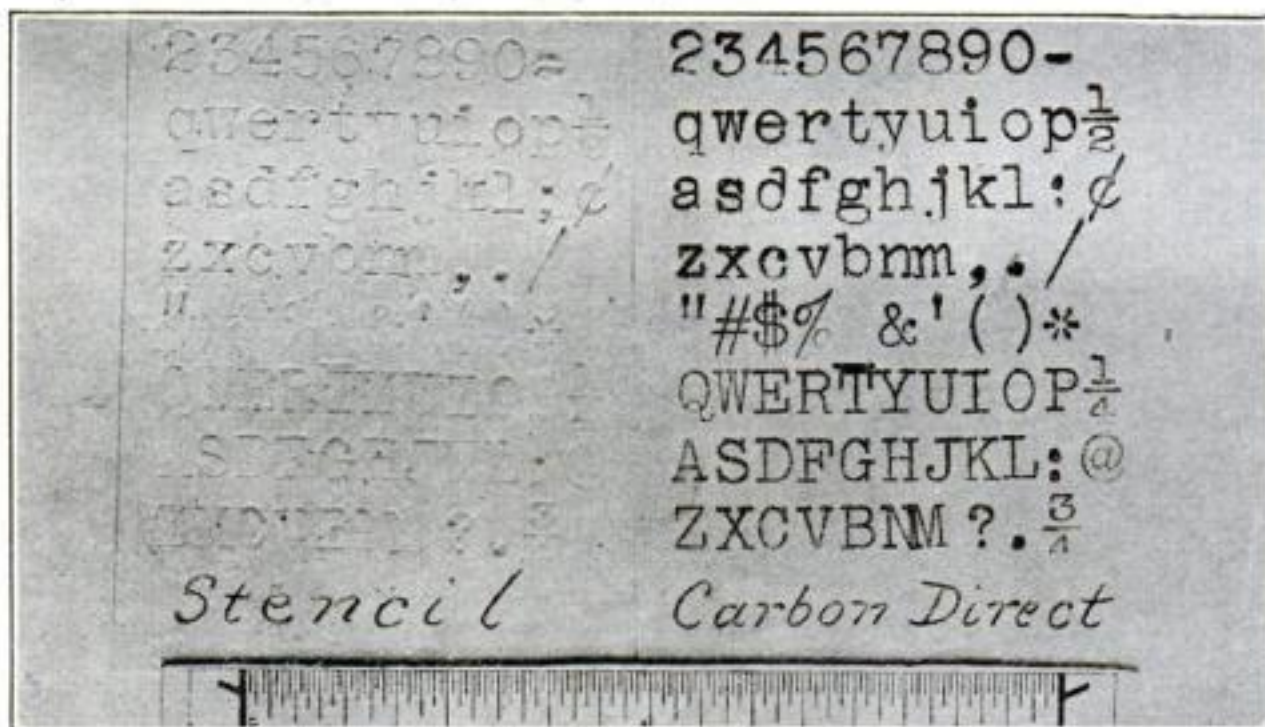
"Some time ago an office of the Department of Justice was astonished to find a confidential letter from its files printed in a magazine. There was a bad 'leak' somewhere. The letter that had been sold to the magazine was obtained, and was found to be a typewritten copy of the original, the latter having been in longhand. This typewritten copy had so many individual characteristics that the copyist might almost as well have signed his name to

it. In breaking a word at the end of a line, for example, he invariably inserted a second dash at the beginning of the next line. Also, he had a habit of following each semicolon with a dash.

"With such personal characteristics as a guide, finding the seller of the letter was a matter merely of elimination among those who had access to the copied letter.

"NOT only may machines of different makes be distinguished readily, but each machine from the same factory presents individual characteristics, sometimes even before it has been used. I have often examined a brand new machine and found breaks in the outlines of a letter, or distortions of the serifs, imperfections too small to be noticed ordinarily, yet tremendously important in fixing the individuality of that particular machine. In other cases machines are individualized through the type being 'off its

(Continued on page 166)



These magnified copies of typewritten letters, in stencil and in carbon, reveal the imperfect type faces and uneven type impressions that give the machine that printed them an unquestioned individuality

Do you use the Popular Science Institute of Standards?

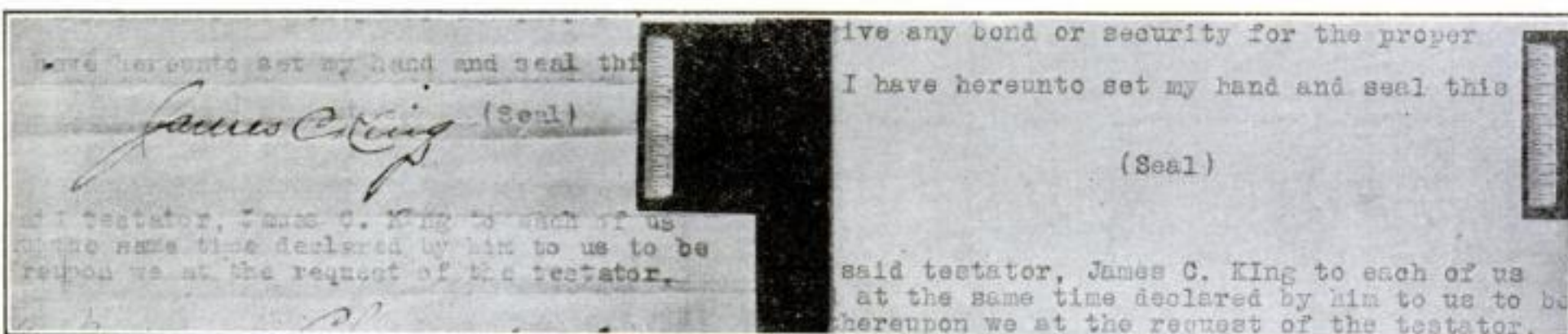
Do you use the Popular Science Institute of Standards?

Do you use the Popular Science Institute of Standards?

Do you use the Popular Science Institute of Standards?

Do you use the Popular Science Institute of Standards?

How many differences can you find in these lines? They were written by five different persons on two different machines—the top four on a machine of one make, and the bottom one on a machine of another make. If you look carefully you will see certain distinguishing characteristics of typewriters and typists, such as differences in the strength of impressions, and imperfect letters. Notice that the fallen *a* in the fourth line evidently is the fault of the typist rather than the machine, for the *a*'s in all the other lines are aligned. It is by scientific study of such peculiarities that different typewriters and different typists are identified when necessary to establish evidence in connection with disputed papers

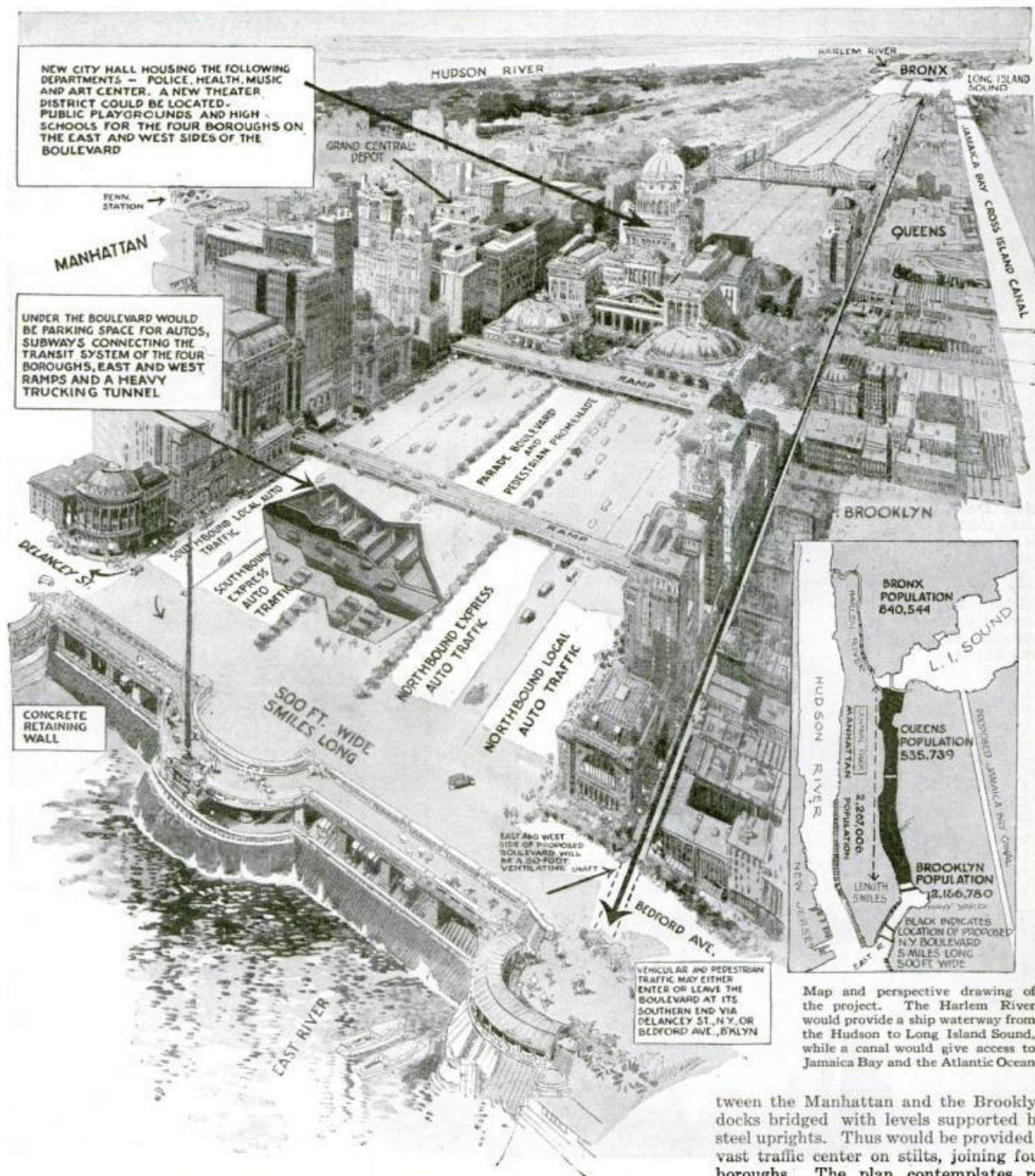


At the left is a photographic reproduction of a disputed will. Mr. Horton testified that every letter in this document had been penciled over. This was done, he inferred, to hide the fact that the cross bars of the *t*'s had been lengthened by pencil to make it appear that the document had been

typed on a machine of a model that corresponded with its date. At the right is a copy of the same document. Comparison between the two specimens brought out important characteristics in the typing of the original document and so supplied valuable evidence concerning the will

Plan to Drain a New York River

Vast Engineering Project to Relieve Traffic Congestion



INCREASING traffic congestion in Greater New York City, which is causing a loss estimated at more than \$1,500,000 every day, recently called forth this vast plan of draining the East River and converting what now is a busy waterway into a five-mile system of automobile and motor-truck highways, subway lines, parking spaces, and city centers.

This particular idea comes from Dr. John A. Harriss, special deputy police

commissioner in charge of traffic, and is under consideration by municipal authorities. If carried out, it undoubtedly will be one of the most tremendous engineering feats ever undertaken.

The project calls for erection of two concrete dams—one at lower Manhattan near the Williamsburg Bridge, the other where the Harlem River joins the East River near Hell Gate. The river then would be drained, and the 500 feet be-

tween the Manhattan and the Brooklyn docks bridged with levels supported by steel uprights. Thus would be provided a vast traffic center on stilts, joining four boroughs. The plan contemplates removal of noisy elevated structures.

From the river bed would be built subway lines, vehicular subway, taxi stands, conduits, city equipment departments, parking spaces, and private and municipal garages. On the top level would be five 100-foot boulevards for autos and pedestrians. Ramps would provide for cross traffic. And midway along the great thoroughfare would be erected an imposing city hall and community center.

They Once Lived

If the Animals of Today Kept
of Prehistoric Monsters

The hairy Mastodon roamed the United States before the last Ice Age, ages ago. Some believe these beasts were hunted by men of primeval times



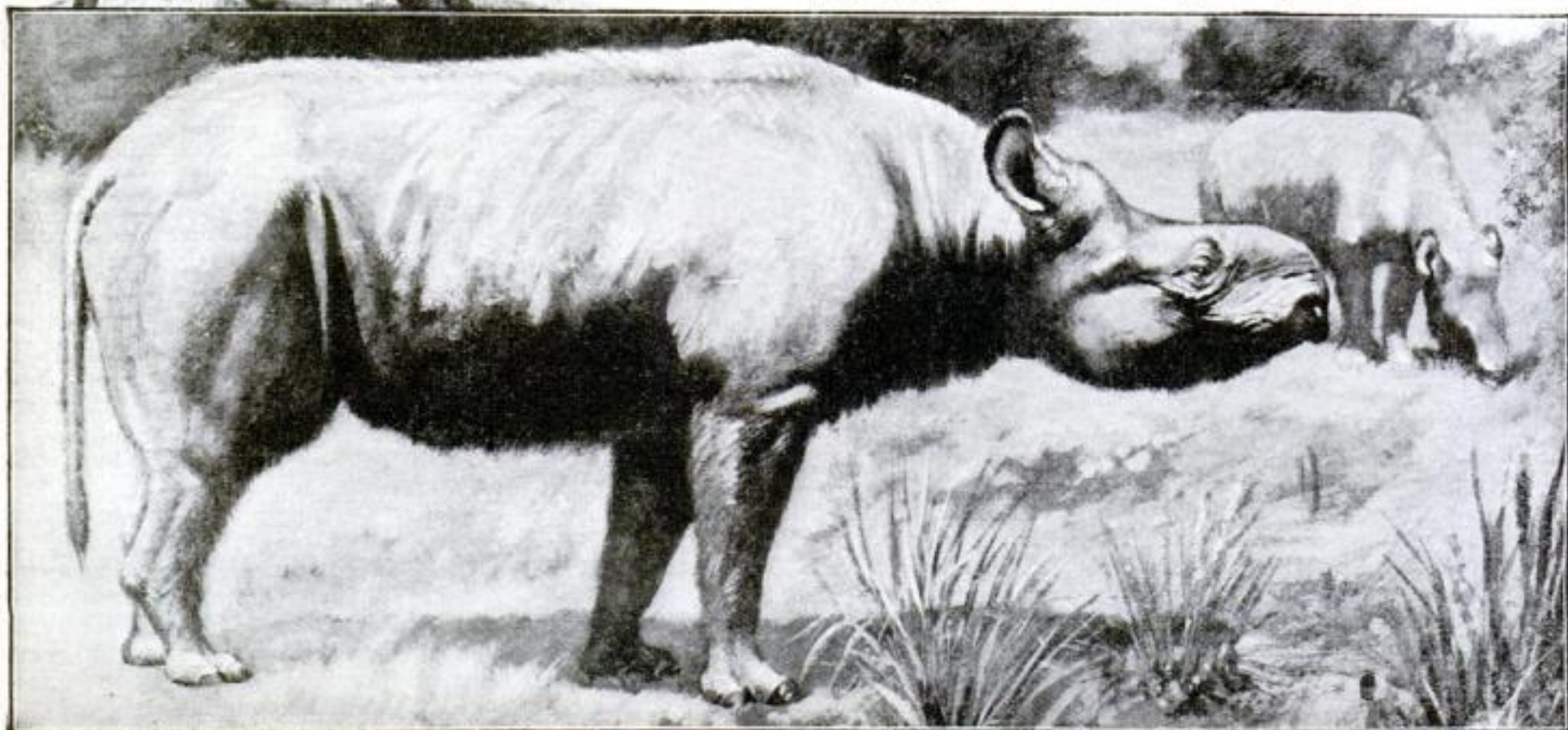
Irish Deer, once plentiful in Ireland and on the Continent, grew antlers weighing 80 pounds and spreading 11 feet across



The Caenopus (below) was an ancestor of the horned rhinoceros. It lived a million years ago, and was about the size of a Jersey cow



Fierce Saber-Toothed Tigers preparing to attack the Giant Sloths, pictured opposite. Above the tigers sit great prehistoric vultures



in Your Backyard

Family Albums, These Pictures Might Appear in Them

Before the Rockies existed, and when Colorado was as flat as Kansas, the terrible Brontosauri, or Thunder Lizards, made the western United States their headquarters. Crocodiles and ostriches are the nearest existing relatives of these monsters that once dominated the earth. The Thunder Lizard was 25 feet long and 12 feet high, yet its brain weighed less than a pound

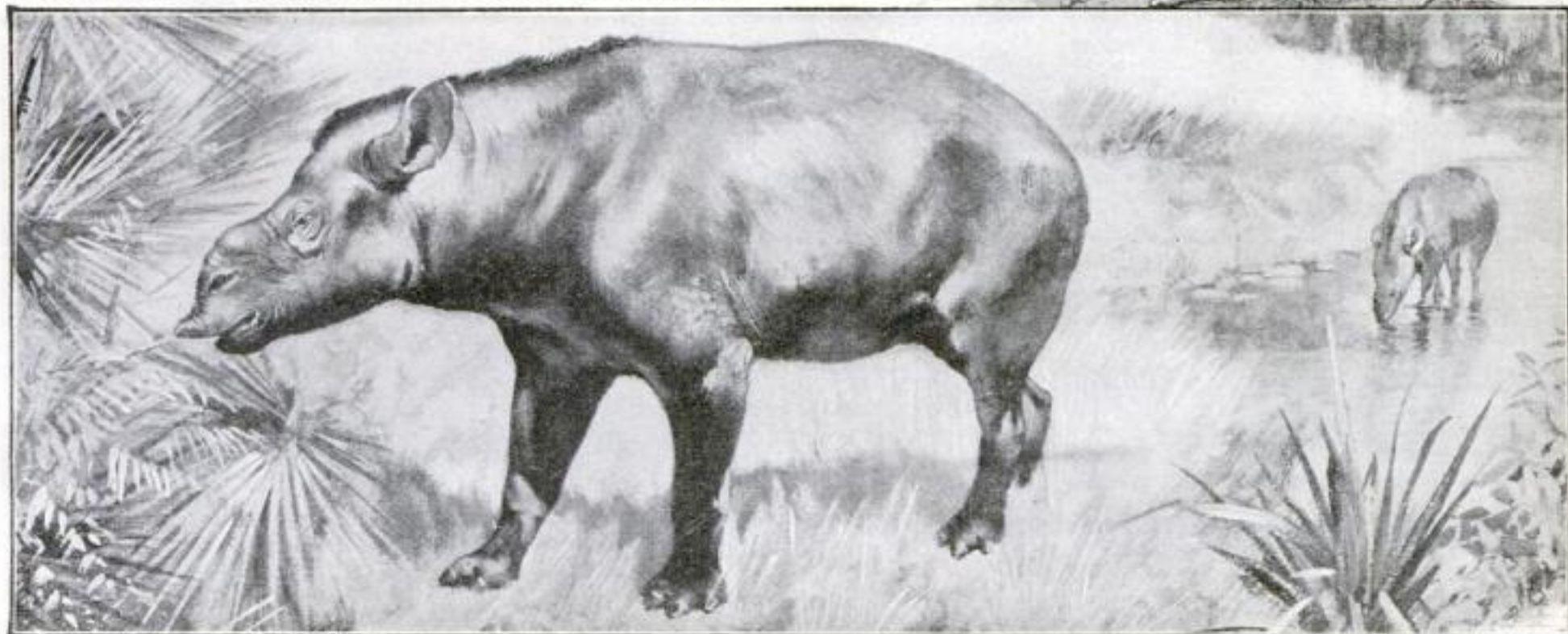


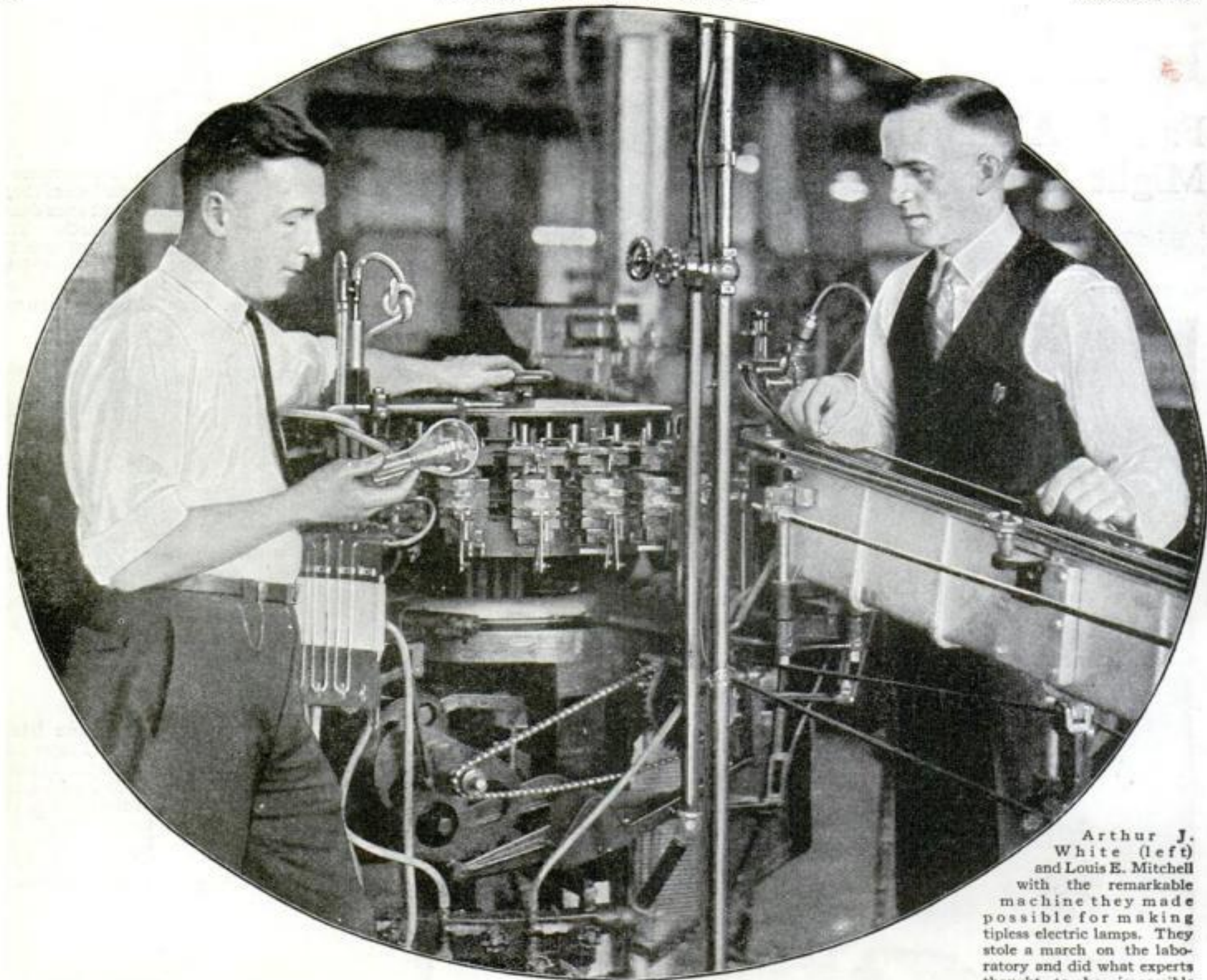
Ground sloths living now are small surviving cousins of these clumsy monsters of past ages. Embedded in their tough hide were thousands of round pieces of bone, forming a coat of armor. Even this was not protection enough from the blood-thirsty saber-toothed tigers pictured on the opposite page

Illustrations from murals by Charles R. Knight, courtesy American Museum of Natural History

Two million years ago the strange Palaeosyops (below) browsed in grass along river banks. Its remains have been found in Wyoming

The huge bird called "Diatryma" (below) could have made a quick meal of the small three-toed horse of prehistoric times. The bird's jaw was 17 inches long





Arthur J. White (left) and Louis E. Mitchell with the remarkable machine they made possible for making tipless electric lamps. They stole a march on the laboratory and did what experts thought to be impossible

They Did the "Impossible"

How Two Mechanics Made Tipless Lamps when Experts Failed

By George Appel

LOUIS E. MITCHELL and Arthur J. White, foremen in the Nela Lamp Division, Nela Park, Cleveland, Ohio, recently were given awards by the General Electric Foundation, established by Charles E. Coffin in recognition of outstanding services performed during the year.

The awards were bestowed for an achievement that outside the industry went practically unnoticed, yet one that marked an epochal event in electric lighting—the production of a true tipless lamp.

For years experimenters had sought vainly to eliminate the little sharp tip on the end of a light bulb. The tip is what is left after the exhausting tube is sealed off when the air is pumped out of the bulb. It causes more than half the breakage of lamps during manufacture and afterward, because it strikes and catches on things. Moreover, manufacture of tipped lamps involves a highly complicated hand process that is slow and expensive. Altogether, the tip had been a prime nuisance.

A remarkable feature of the success of Mitchell and White is that experimenting is not their business. They are employed to work out production methods in lamp manufacture. After experimenters in the Nela laboratories have developed a new type of lamp, and after engineers have developed the machinery, Mitchell and White take hold, organizing the shop system and training the key workers.

In the matter of the tipless lamp, they stole a march on the laboratory staff and did the job some experts thought was impossible.

"WE BOTH have been interested in tipless lamps for a long time," White told me. "A little more than four years ago, we had some idle time on our hands between organization jobs, and we decided to see what we could do about those tips.

"We tried all the old methods of eliminating the tip, to see if they furnish any practical ideas, but we found they all had drawbacks that couldn't be overcome."

Mitchell, who is round faced and jovial,

and White, who is slim and thoughtfully solemn, spoke alternately, each supplying points the other overlooked.

"THEN we thought of running a little tube up through the base," they continued. "We thought if we could connect a small tube to the inside of the lamp through the glass standard that holds the filament, we could exhaust it through that and seal it.

"The idea looked good, but we hit a snag trying to carry it out. The tube could be welded in, but we couldn't find any way to punch a hole through the end to the inside of the lamp. I'll bet we tried a hundred ways of doing it, mostly different ways of poking it through with wires. None of them worked.

"Then we tried air pressure. We sealed the extreme end of the little tube and heated it and brought the end and the standard to a plastic state by heat. Just as we thought, the air confined in the little tube expanded enough to blow the hole through. But it wasn't a good pro-

(Continued on page 169)

Do You Know How to Wash Your Hands?

Most of us don't—How
to care for your
skin in the
winter

By
Charles
Mallory
Williams, M.D.

ONE cold day last winter a man came into my office complaining of troublesome itching of his hands.

"I suffer this way whenever we have a cold spell," he told me. "At other times I am not bothered. I don't know how to account for it."

On examining him I found the skin very dry, with a few tiny scales where he had scratched. The skin was extremely irritated, but there was nothing radically wrong with the man. He simply didn't know how to take care of his skin—in short, didn't know how to wash himself—in cold weather. He had exposed his hands to the cold and wind until they had become dry and scaly. Then he had aggravated this condition by further drying his skin with hot water and strong alkaline soap.

There is nothing unusual in this case. Few people understand how to protect and care for their skin in the cold of winter. The result is evidenced in the increasing prevalence of chapped hands and wrists, cracked lips, itching legs and chilblains in these days of silk hosiery, low shoes, liquid soap, and paper towels.

KNOWLEDGE about your skin, its structure and its functions, is extremely important, because its condition has a vital bearing on your personal health and comfort. Briefly, the skin consists of a tough layer, like fine leather, which serves to protect the flesh beneath from injury and from cold, and to support the nerves and blood vessels, oil glands and sweat glands that run through it. Above this layer is a thinner, softer layer, the part which we can see and touch. This is constantly wearing away, and as constantly renewed from below. It has no nerves nor blood vessels, so a slight injury produces neither pain nor bleeding. Also a slight injury leaves no permanent scar. In fact, every time you wash or shave, some of this surface layer comes off.

The oil and sweat glands supply oil to keep the skin soft and pliable. The sweat glands, besides supplying a little oil, secrete water in quantities, depending on the amount needed to cool the body by evaporation.

What happens when you go out into the cold? First, the blood vessels contract, causing pallor; the skin feels cold and shriveled. Then, if you are fortunate enough to have good circulation, the blood vessels dilate again, causing a flushing and a feeling of warmth. At the same time, the secretion of sweat is checked, to prevent loss of heat that would be caused by evaporation of the water. The skin becomes dry, partly be-

The Mistakes We Make

DOCTOR WILLIAMS, a famous New York authority on the care of the skin, says that we bring upon ourselves much of the skin irritation of wintertime by too much soap and water and too little clothing.

He points out the mistakes most of us make and tells us how to avoid them.

His advice is of vital importance to thousands who suffer needlessly in cold weather.—
THE EDITOR.

"If your skin gets dry and harsh in cold weather," says Doctor Williams, "beware of strong soap and hot water. Wash your hands as little as possible and dry them quickly and thoroughly"

cause less sweat is secreted, and partly because what little sweat still is formed is evaporated rapidly by the warmth of the body and the dryness of the winter air.

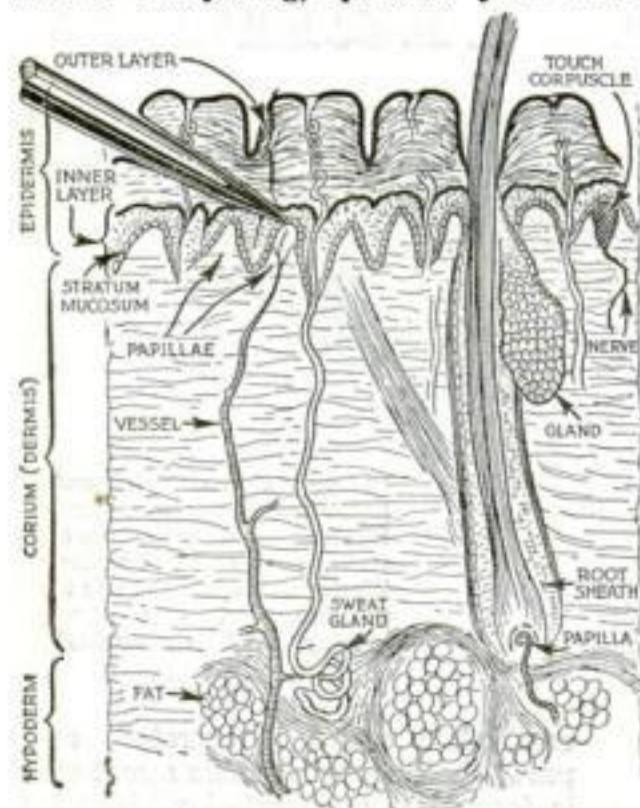
IF THE exposure is repeated often, there are changes in the formation of the outermost layer, which becomes more horny than usual, and probably there are changes also in the oil glands. All these alterations are increased by wind, which makes evaporation more rapid and increases the sensation of cold. There result, then, the sensible effects with which we are all familiar. The skin of the hands, especially over the knuckles, becomes a little thicker than usual, and feels dry and harsh. Fine scales appear on the surface, and if these are not shed as they normally would be if they had not been toughened by the cold, they turn a dirty gray.

This change in color appears especially over the elbows and knees, and on the skin of the legs just above the shoe-tops. You needn't try to wash this dirty color off, for you will only make the skin tender and help to chap it. The dry, thick skin is not so flexible as usual. Cracks appear over the joints, especially the knuckles, and there begins an itching that may make your life a burden.

WET cold has a somewhat different effect. If you are run down physically or if your circulation is poor, long exposure to cold and wet, like standing in wet shoes in the slush of spring, may lead to chilblains. These are dusky swellings in the skin, usually on the feet, but sometimes on the hands, which itch and burn abominably when the skin is warmed, but which, curiously enough, become fairly comfortable when the skin is cold. They are tender and sensitive, easily injured, and when once they start they are likely to last until warm weather comes.

If you want to avoid all these extra woes of winter and early spring, you must begin by protecting your skin as far as possible. First of all, don't let it get cold. Fortunately, your face is tough, and probably won't give you much trouble, unless you are cursed with a particularly sensitive skin—then you may get cracked lips if

you aren't careful. Try to keep your hands and feet always warm and dry. Wear woolen or fur gloves if necessary. Above everything, protect your feet



The structure of your skin. Beneath the protective outer layers are the oil and sweat glands that keep the skin soft and pliable. Too frequent washing with hot water and soap dries and cracks the skin in cold, windy weather

from the wet. The cold of outdoors, of course, is the greatest enemy of the skin, but you may have considerable trouble even if you stay in the house. There it is excessive dryness that you have most to fear.

I REMEMBER one patient, troubled with skin irritation, who couldn't account for the fact that her skin was like parchment, her hands and wrists chapped, and the linings of her nose and throat dry. She said she always was careful to protect herself against the elements on the few occasions she ventured out in winter.

On questioning her I found that in the heating apparatus of her home there was no provision whatever for supplying moisture to the air. Cold air cannot hold as much water vapor as warm air, and when winter air is raised from 20°F. to 70°F. without any provision for supplying moisture, its relative humidity becomes as low as that of the desert, and evaporation from the skin is correspondingly rapid. Any means you can improvise to keep the air of your house and office moist, such as placing pans of water on the radiators, will help to prevent chapped hands. It is well, too, to make sure your furnace has some means of humidifying the air. If it has not, almost any furnace expert can remedy the defect.

Protection of the skin means more than wearing warm clothes. One of the most

important things to guard against is an excessive use of strong soap. Strongly alkaline soaps, notoriously injurious to the skin, are doubly so in cold weather. Even good neutral soaps may be too strong for a very dry skin, and there are many people who find it impossible to take a hot bath more than once a week in winter on account of the intolerable itching it produces. A cool bath is better, for it does not remove so much of the natural oil of the skin.

IF YOU find that a hot bath with soap makes you itch all over, and especially where the clothes rub or press upon the skin, try a warm bath without soap, and if you are still uncomfortable, try the next time, a cold bath.

Each individual must determine the temperature and frequency of his baths to suit his own needs and comfort. Wash enough for cleanliness, but don't overdo it; and be guided not by what others do, but by the reaction of your own skin.

If you are blessed with a sound, supple skin with plenty of natural oil, bathe as

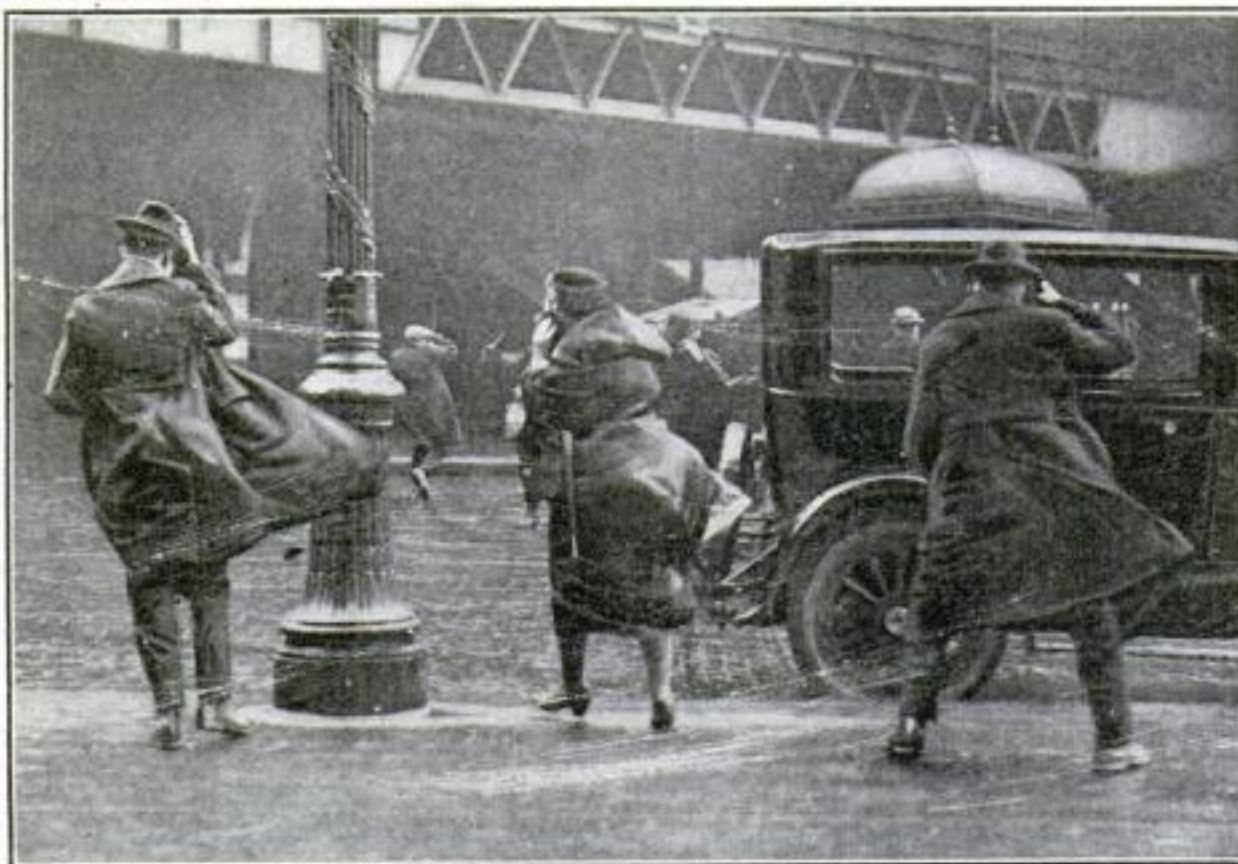
After washing, rub in a little of a good hand lotion. One of the best known is a mixture of equal parts of glycerine and rose-water. This will do very well for most people, but there are some who cannot use it, for they find that glycerine is very irritating. A lotion that can be used by almost every one, is an emulsion of olive oil made up with tragacanth. A small quantity of this should be put on the skin and rubbed in until it disappears.

In some cases a good cold cream, or similar preparation will serve better than any lotion. Some people, too, find that pure olive oil does as well as anything. Whatever is used should be applied after every washing, before going out into the cold, and again on coming in. It is better to use a little very often than to use a great deal once or twice a day. All that has been said applies particularly to the hands, because they must be washed more often than any other part of the body, and are most apt to give trouble.

Next to the hands, the part most frequently affected probably is the six inches of skin above the shoe tops. There are

two reasons for this: first, it is often insufficiently protected by clothing; and, second, the circulation in the lower part of the leg is very often sluggish. If the local circulation is poor, the local nutrition is poor, and a poorly nourished skin will itch, chap, crack and become infected, where a well nourished skin would remain healthy.

KEEP the legs warm by proper clothing, and help the circulation by proper exercise. For a local application, the lotions and



Much suffering from skin troubles always follows bitter winds such as those depicted in this New York street scene, says Doctor Williams. Too much washing with soap and water, and inadequate clothing are responsible. Wash yourself carefully, clothe yourself warmly enough, and you need not suffer

much as you please; but if you are cursed with a skin that gets dry and harsh in cold weather, cracking easily, beware of soap and water.

You can avoid a good many washings of your hands by keeping them clean in the first place. For example, wear gloves whenever you have a particularly dirty job to do, such as oiling an automobile or tending the furnace. You can't get along without washing, however, so the method of washing and the after treatment are important.

WASH with warm, rather than hot water, rinse the soap off completely, especially if it is liquid soap, and dry the skin quickly and thoroughly immediately afterward. A wet skin is a cold skin, and a cold skin chaps. In using paper towels be sure they are sufficiently absorbent. If necessary, use several to dry your hands. A clean, soft, dry towel is the only kind that is really satisfactory.



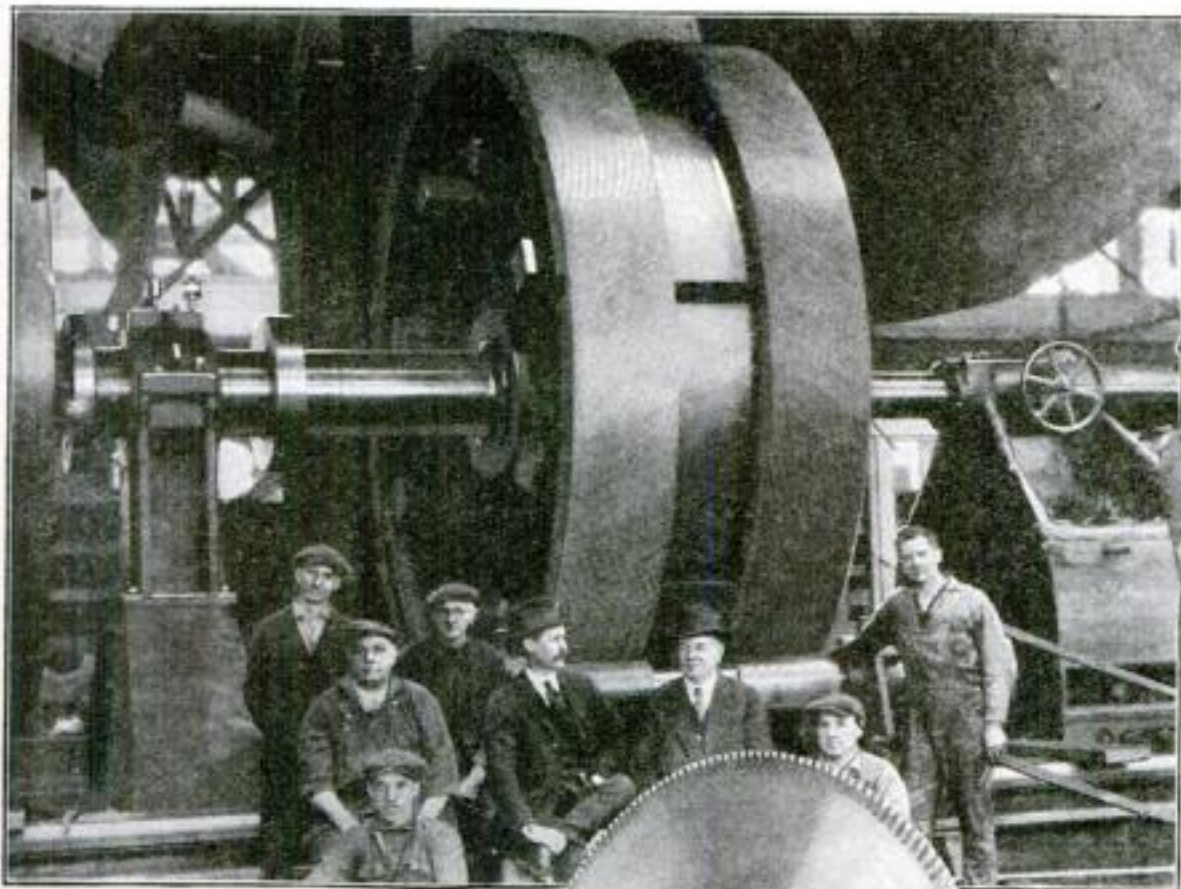
For frostbite, the old-fashioned remedy of rubbing the frozen member with snow is as good as it ever was. In this way the flesh thaws gradually and circulation is resumed

cream above mentioned are useful. Also there is an old-fashioned country remedy that often is successful. This is to rub a

(Continued on page 170)

The Biggest of Their Kind

Have You Ever Seen Anything to Equal Them in Size?



Machinists in the Philadelphia Navy Yard who helped to turn out this mammoth gear wheel claim it is the biggest gear in the United States. It weighs 70,000 pounds, and was installed as part of the powerful machinery of the U.S.S. *Dobbin*

Nearly three times as tall as a six-year-old child, the Oriental vase (below) has been accorded the world's record for size. Santa Barbara, Calif., claims it. Have you ever seen a vase as big as this?



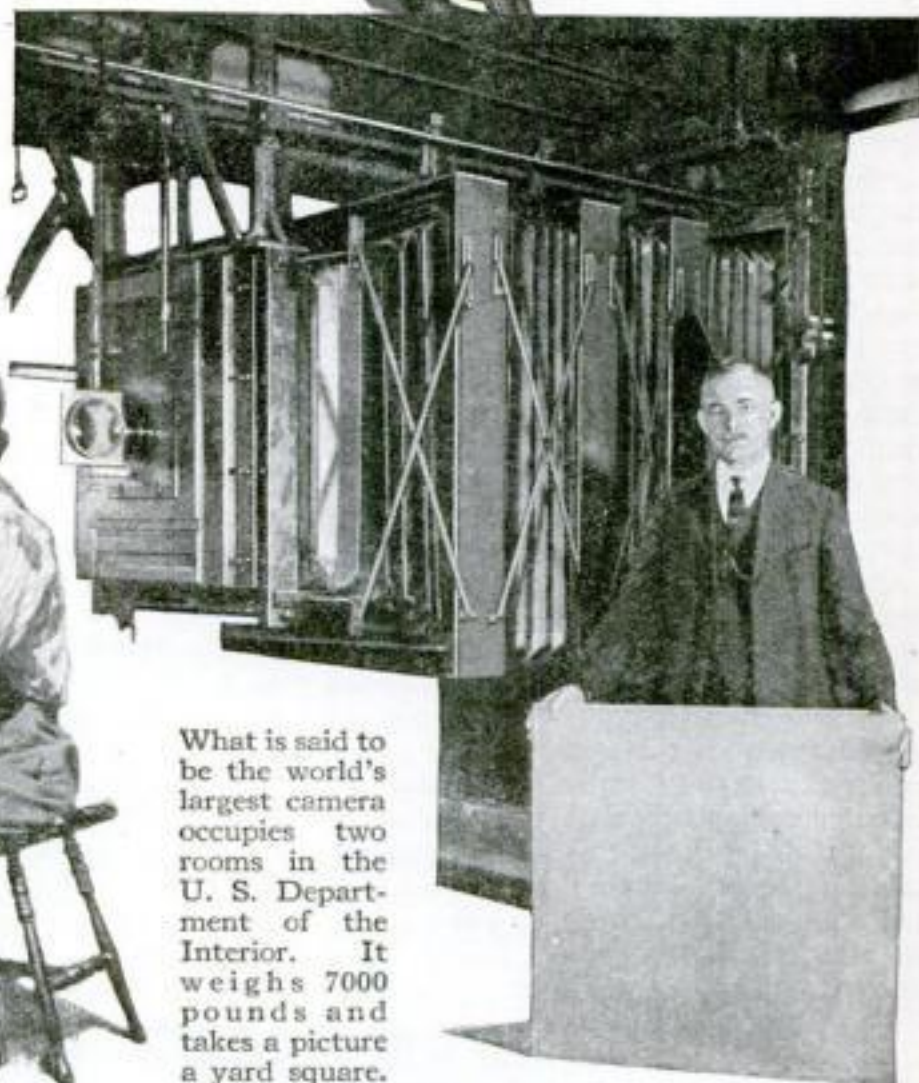
Henry E. Sillicocks, of Waltham, Mass., claims the ball of string he has wound is the largest ever made



A tall Philadelphian can't begin to reach to the top of the circular saw shown at the left, said to be the world's largest. It measures nine feet in diameter and weighs 795 pounds



After it had lifted a shaft weighing 23 tons from the steamship *Majestic*, this block and tackle was pronounced the strongest ever made



What is said to be the world's largest camera occupies two rooms in the U. S. Department of the Interior. It weighs 7000 pounds and takes a picture a yard square. It is operated by electricity

Endless Twelve Miles

"We Can Tap It for



THAT better electric generators, more efficient storage batteries, new methods in wire transmission and even radio transmission of power can be expected in the future scarcely need be said. Certain it is that if engineers find at their disposal any such tremendous source of power as lies in the crust of the earth, they will prove capable of developing ways to utilize it.

It was almost 20 years ago that Sir Charles first brought to the attention of science the possibility of utilizing the earth's interior heat for the development of power. At the time the suggestion was regarded as an interesting scientific speculation. Hundreds of scientists since then have discussed the proposal and studied it from a theoretical standpoint. Meanwhile, though, Sir

By Raymond J. Brown

WANTED: \$100,000,000 to assure mankind of all the heat and power that will be required until the end of time!

If you were to read somewhere an advertisement worded substantially as the above, your curiosity undoubtedly would be piqued. Probably if you paused to analyze such a statement you would become suspicious of the good faith of the person who framed it. For it does seem absurd that for an amount of money less than the world's present weekly coal bill, an amount only about three per cent of what is required to run our government for a year, there could be accomplished any such tremendous thing as driving every factory and warming every house that ever will stand on earth.

And yet this amazing suggestion is made by one of the world's foremost men, an engineer and scientist who has contributed immensely to the welfare and comfort of the human race. Moreover, his suggestion and his definite plan for carrying it out have been indorsed and declared sound by other eminent engineers.

What he proposes to do on a gigantic scale already has been done successfully in a smaller way. Indeed, only within the last few weeks the United States Government officially admitted the feasibility of the plan by assigning a group of experts to investigate its possibilities.

This man is Sir Charles A. Parsons, K.C.B., F.R.S., the noted British scientist to whom we are indebted for the present-

Gate valve and steam recording instruments of America's first power-generating plant to be operated by natural steam from underground. For this plant, at Healdsburg, Calif., engineers tapped an enormous supply of steam by drilling only 300 feet into the ground. The heat at the bottom was more than 600 degrees, and at the surface about 350 degrees. The steam pressure of the plant ranges up to about 70 pounds

day widespread use of the steam turbine. The way in which he proposes to make man forever independent of coal, oil, and other similar sources of power is by sinking a shaft 12 miles deep and drawing out the tremendous heat of the earth's interior.

Now you may raise the objection that were such a shaft to be sunk, it would be impossible to distribute the resulting power over the whole earth. That is true, today, but you must not forget that engineering skill has not reached its limit yet. Power today is carried over distances that a quarter of a century ago would have seemed unbelievable.



Sir Charles A. Parsons, K.C.B., F.R.S., noted British scientist and father of the steam turbine, who declares the world's heat and power problems could be solved forever by sinking a 12-mile shaft and tapping the tremendous heat of the earth's interior

Charles quietly experimented, until now he has been able to announce that it is thoroughly practicable from an engineering point of view, and that the only bar to beginning work immediately is the money necessary to finance the project — \$100,000,000.

Surrounded by a group of famous

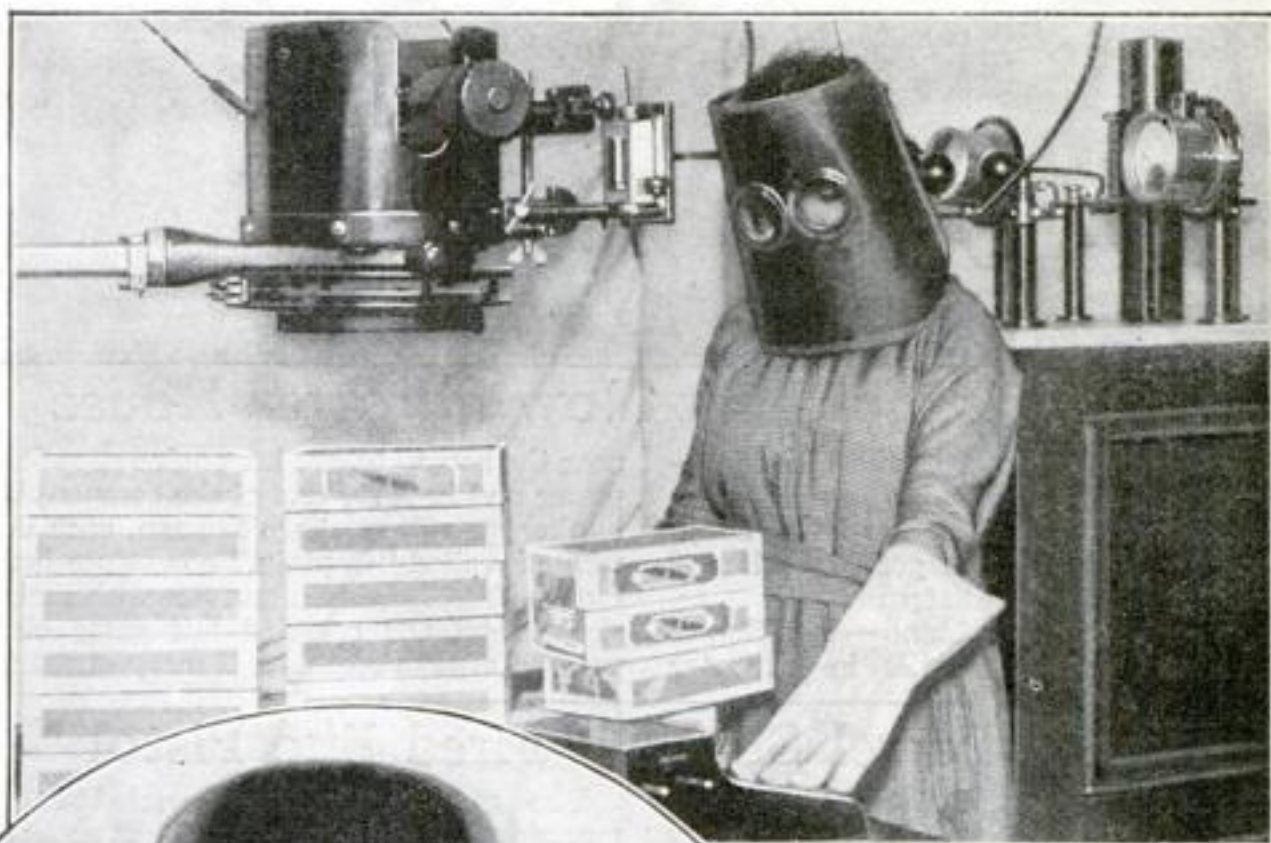
New Masks for Peacetime Uses

Strange windowed helmets cut down casualties in industry, shielding workers' faces from glare, heat, and fumes

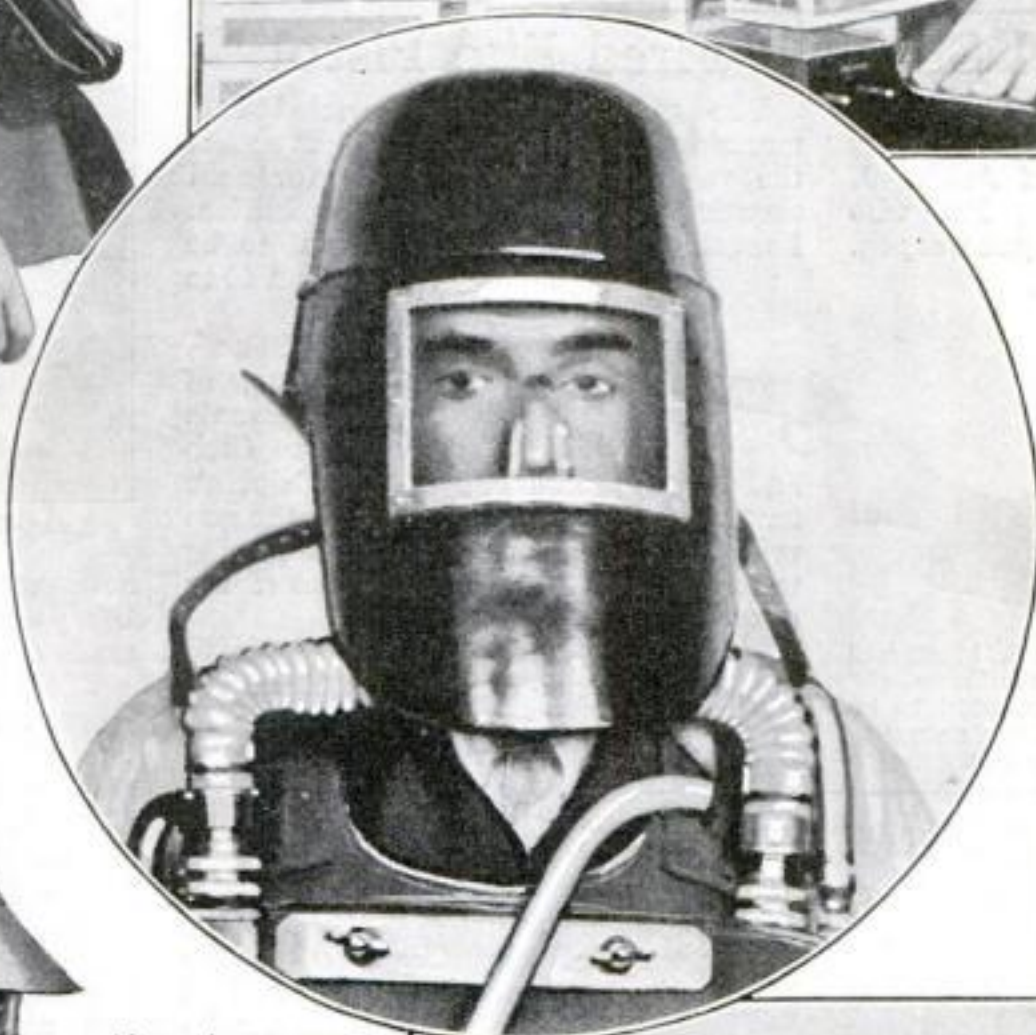


Improved helmet and face shield for firemen

The fact that 200,000 industrial accidents result in eye injuries in the United States each year indicates the need of masks, helmets, and goggles such as pictured here



In exposing imported cigars to X-rays to rid them of the destructive cigar worm, the worker is protected by this odd headgear and by gloves

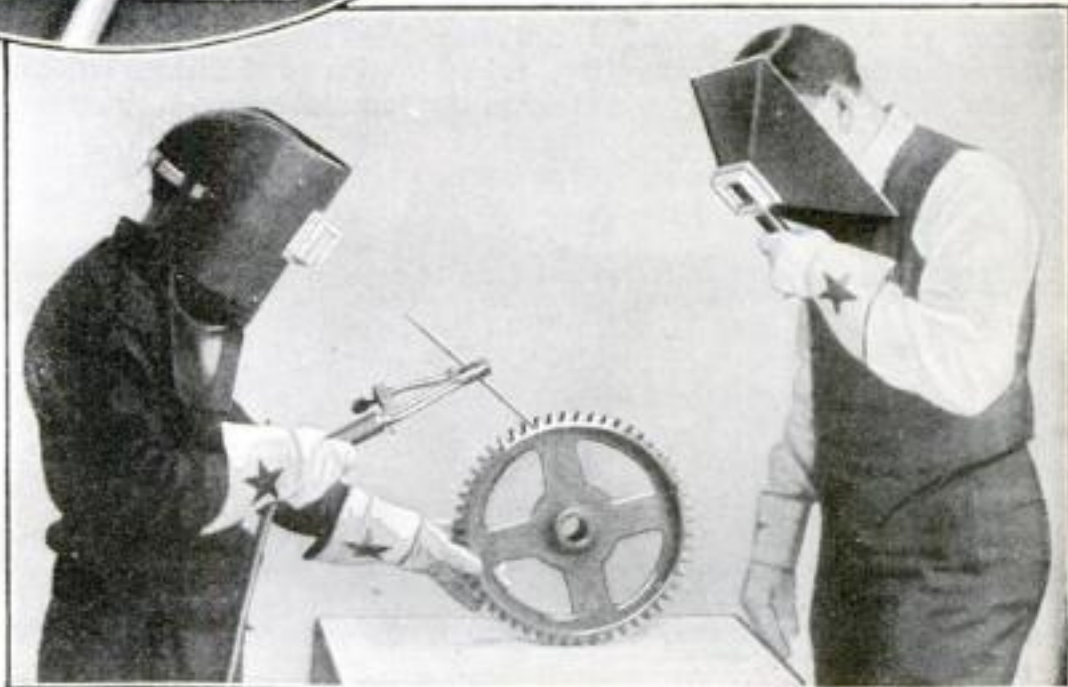


Above is an oxygen mask for mine rescue work. The rawhide helmet is fitted with a fire-proof mica panel

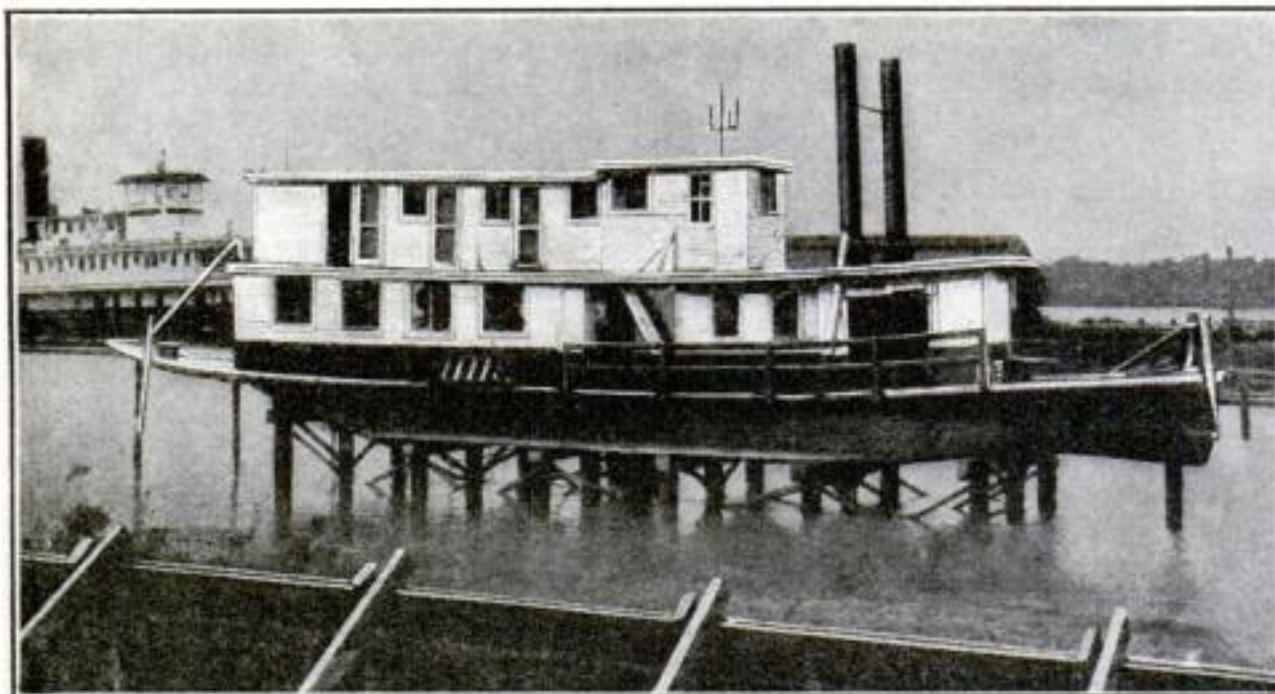
Protection of head and eyes from falling debris is given by the helmet worn by the man at left. This helmet, with gas mask, is designed especially for use in fighting fires



In sports, too, the eyes of players are being safeguarded. Here is a wire mask specially made for basketball players



The heat and glare of electric arc welding would be hazardous without face shields such as these. The welder's shield (left) and the inspection shield (right) contain colored glass windows



Old Mississippi Boat Now a Power House

THE fighting heart of this old Mississippi steamboat—her engine—had valuable life in it after her worn body, aged by 30 strenuous years, no longer could battle the great stream.

So her owners, the Standard Oil Co., of Louisiana, put her on stilts in the water

near the bank. There her engine supplies power and heat for one of the company's bunkering offices. Two firemen, each of whom is called "Captain," constitute her crew. Passing craft salute her with their sirens, and the crippled but game old veteran always sounds a throaty answer.

Double-Barrel Shotgun Fired like Pistol

WHAT is claimed to be the smallest 20-gage shotgun in the country is shown here in the hands of Arthur J. MacDowell, of Philadelphia, Pa., who is the designer of this odd-shaped weapon.



Arthur J. MacDowell firing the "sawed-off" shotgun, which he invented as a protection for the motor tourist

The gun is a double-barreled one, measuring 16½ inches over all. It shoots the regulation 20-gage shells for field shooting or clay target competition. Loaded with buckshot it is said to be deadly at from 40 to 60 yards.

Mr. MacDowell, who is secretary of the Pennsylvania Railroad Gun Club and is considered one of Philadelphia's best trap shots, says he designed the gun primarily to be of use to motorists touring in lonely, out-of-the-way sections of the country.

It will take a nifty highwayman to look this double-barreled pistol in the muzzle without making for cover or sticking up his hands.

Ontario Trapper Drives Team of Wolves

A TRAPPER of northern Ontario, Canada, Joe LaFlamme, recently succeeded in what is said to be the first attempt to tame and harness a team of timber wolves. He obtained the two wolves while they were young, raised them carefully, and finally tried them out,

at first securely muzzled. After several trials he removed the muzzles, and the wolves, sensing freedom, bit fiercely at the harness in order to break away. But LaFlamme, anticipating this, had substituted chains for leather, and after ineffectual biting, they submitted.

Invents Giant Camera for Long-Distance Photos

MANY times ground rules prevent camera men from getting pictures of the slide to second base, or the touch-down, which is the most thrilling play of the whole game. M. S. Walker, photographer for a big New York newspaper, was disappointed a few times, then made for himself a giant camera which, he says, will snap objects 300 feet away.

Measuring five feet long, this monster, which is said to be the largest practical



Long-distance camera and its inventor

newspaper camera in the world, weighs 100 pounds, despite the fact that it is made of aluminum.

The lens, the secret of the camera's power for bringing subjects at long distances up to the equivalent of 20 feet for smaller cameras, was manufactured in Germany. It is a copy of lenses used by German airmen during the war, long kept secret by them from the rest of the world.

It takes two men to manipulate the camera, which rests on a tripod made like a battleship's gun pivot and is capable of being revolved or moved up and down as necessity demands.



Joe LaFlamme, trapper, driving his team of real timber wolves across the snow in the wilds of northern Ontario

One-Arm Steeplejack Hangs on with His Teeth

CLINGING to spires and flagpoles high in the air is a job that takes more than ordinary courage at best, but Henry Wernsing, a steeplejack in Baltimore, Md., does it with only one arm.

When blood poisoning set in his left arm, necessitating its amputation, he wouldn't change his job, but went on filling his contracts. His right arm seems to have developed the strength of the missing member and with the aid of his strong teeth and jaws, Wernsing keeps on climbing.



The one-arm steeplejack at work

Light Colors Aid Growth

YOUNG animals, and presumably children as well, grow more rapidly in rooms with walls painted in light, cheerful colors than they do in dark-painted apartments. Such is the conclusion of Dr. H. A. Gardner, of the research laboratory of the Paint Manufacturers' Association, as the result of recent experiments with guinea pigs. His experiments showed that pale blue, white, and light tan were most conducive to rapid growth.

The World's Largest and Smallest Steers

WHAT are said to be the world's largest and smallest adult bovines met recently, and were photographed together.

The giant is reputed to be the world's largest steer. He is a full-blooded Texas longhorn, weighs 4200 pounds, and is six feet four inches high. The midget comes from a dairy strain and is only 24 inches high.



Giant steer more than six feet high, and midget only 24 inches



Guns 400 Years Old Look like Toys Now

THE past and present were put into startling contrast recently at Fort Hancock, New York, when Frank Lloyd, a motion-picture producer, set out three old-fashioned Spanish, English, and Corsair cannons of the sixteenth century.

When placed alongside some of the

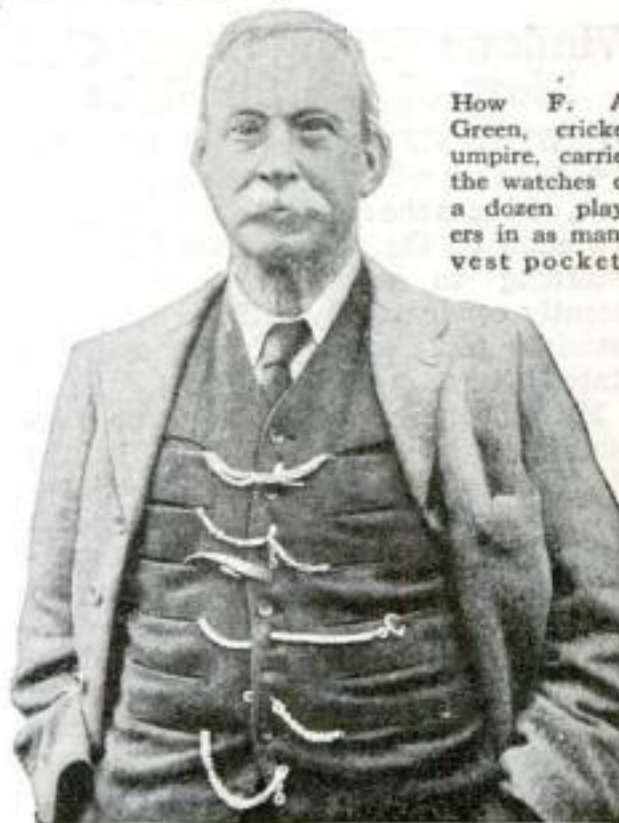
modern engines of warfare they looked like odd little toy cannon. The photograph shows a modern field piece and these old cannon side by side, the latter being muzzle-loaded by a boy dressed in the style of the period when these cannon were in vogue.

Rome to Have the World's Tallest Skyscraper

ITALY soon will have the tallest skyscraper in the world—more than 300 feet taller than the Woolworth Building in New York City—if a recently reported decision of Premier Mussolini is carried into effect. The huge structure will be built on plans drawn by the noted Italo-Argentine architect, Mario Palanti, who already has erected several colossal buildings in Buenos Aires.

Palanti proposes to erect in Rome a structure with 88 floors, 1100 feet high, with a frontage of 1000 feet. It would contain 4500 rooms, 100 large halls, a huge theater, a gymnasium for the training of Olympic athletes, and a concert hall. It would be the Roman community center. The general plan is in the form of a pyramid, with a massive base narrowing to a high central tower.

The Woolworth Building, at present the tallest in the world, has 51 stories and is 792 feet high.



How F. A. Green, cricket umpire, carries the watches of a dozen players in as many vest pockets

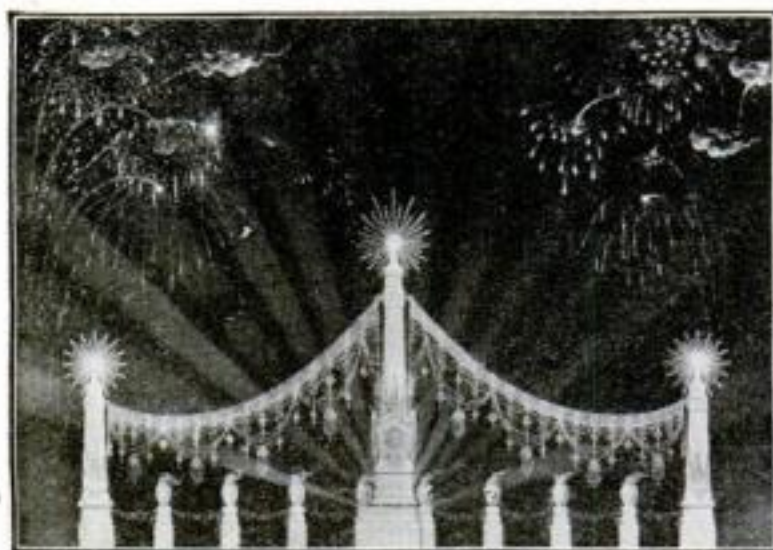
Cricket Umpire Carries a Vest Full of Watches

CRICKET is a popular sport in England. Carrying a watch is a necessity. But the two don't mix. Therefore, F. A. Green, a well known Lewisham cricket umpire, solved the difficulty and added to his popularity by having a special vest tailored with as many watch pockets as possible, as shown in the photograph. He calls it a "cricket waistcoat," and he can easily take charge of a dozen timepieces for the players whose games he umpires.

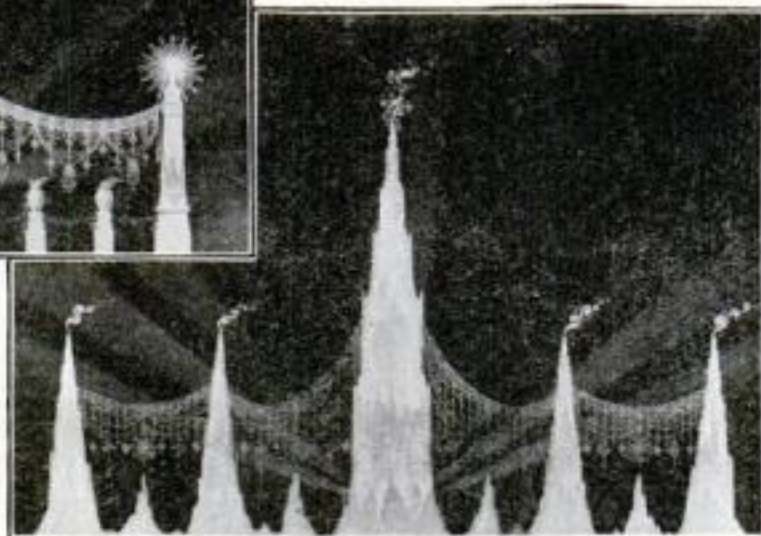
New Gasoline Substitutes

TWO new substitutes for gasoline recently have been developed by French chemists. In one, the composition is lignite coke and water, while the other is made from animal and vegetable fats heated with chloride of magnesium or sodium. The process is said to be simple.

Scientific Lighting Creates Spectacular Color Displays



THESE two dazzling night displays, representing crystal towers glistening with gems of many colors, were produced at recent state expositions by means of giant searchlights, playing their beams upon thousands of polished jewels. The display at the left was created at Brockton, Mass.; the one below at Syracuse, N. Y.



THE science of producing spectacular lighting effects attracted record crowds to two large Eastern expositions this year—the State Fair at Syracuse, N. Y., and the Agricultural Fair at Brockton, Mass. Features of each exposition were massive columns studded with jewels and adorned with festoons, colored smoke, and electrical fireworks, all painted in varying and beautiful colors by bat-

teries of giant searchlights using nearly a quarter of a billion candlepower in each instance of this modern decoration.

Thirty thousand hand-cut jewels were used. Attached to each jewel was a mirror, so that when the enormous searchlights played on these towers of colored crystal, the effect was most striking.

At the Syracuse Fair a mammoth artificial limestone cavern was built in front of the grandstand, having a length of 157 feet and a height of 90 feet at its highest point. The stalagmites that rise from the floors of such caves like enormous icicles were duplicated in great piles of jewels, the center one being 90 feet tall. All were covered with additional thousands of gems. Steam issued from their tops and colored lights played through this.

At the Brockton Fair was a jewel display 120 feet wide and 75 feet high, consisting of three large pillars crowned with sunbursts and fringes of jewels, supplemented by illuminated steam urns.

So that the thousands of people might hear a lecture on "Light and Color," by W. D. Ryan, director of the General Electric Company's illuminating engineering laboratory, a new type of hornless loudspeaker was used. This loudspeaker is said to be able to project the voice clearly for a quarter of a mile in any direction.

Windows Facing South Get Most of the Sunlight

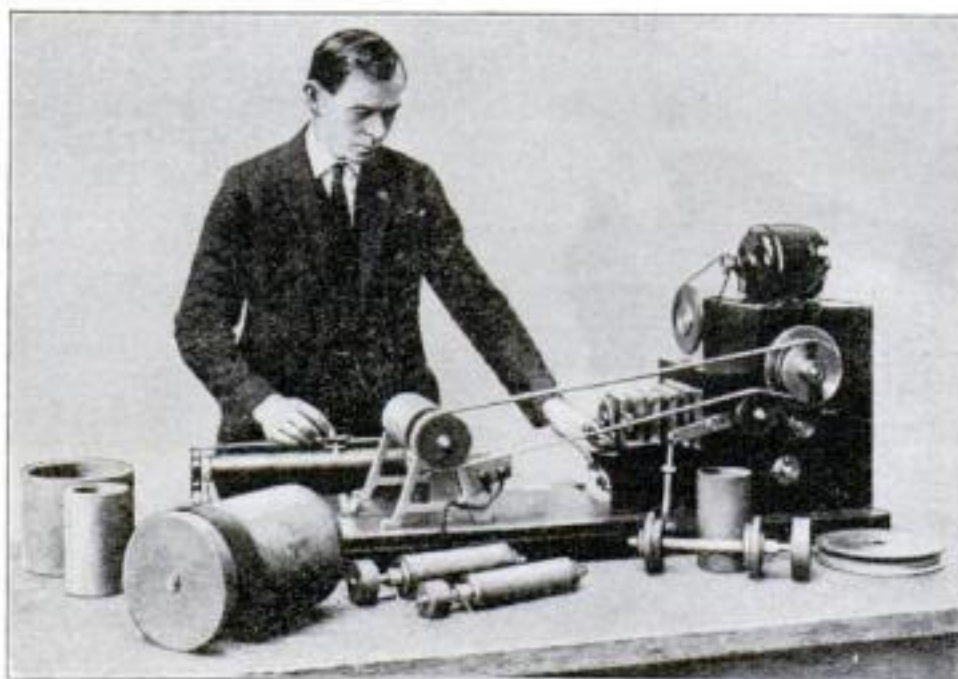
A WINDOW on the south side of a building will get, in the course of a year, 45 times the amount of sunlight that a window on the north side will receive, according to exhaustive experiments recently conducted by William Kunerth, associate professor of physics at Iowa State College, Ames, Ia.

Mr. Kunerth's experiment does not include daylight, only sunlight. While the north window is getting one unit of sunshine to 45 for the south window, the east window receives 27 units, and the south-east window gets 38 units, according to Mr. Kunerth's calculations.

When the sunshine strikes a window-glass at too sharp an angle, the sunshine is reflected and hence does not penetrate the room, to make it warmer.

New Camera Photographs Revolving Pipe

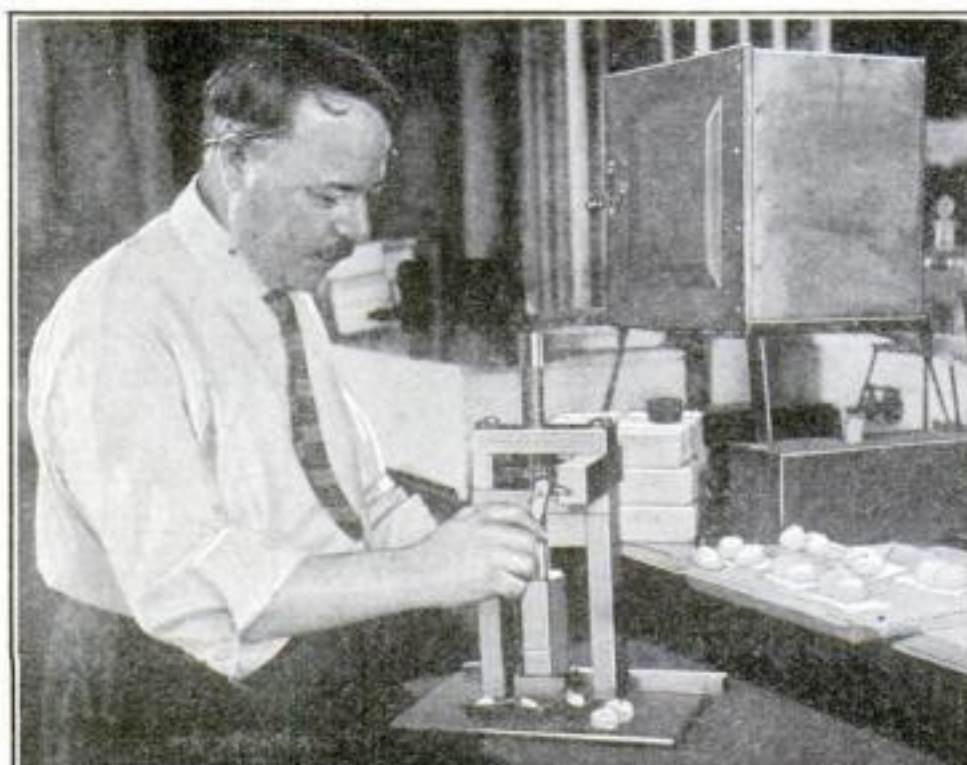
A NEWLY invented camera makes it possible to photograph the entire outer surface of a sample of pipe that has been exposed to corrosion under ground. The pipe is rotated on a cylinder that is synchronized with the camera so that the film moves automatically at the same rate. The photograph shows the entire pipe's circumference.



The Nation's Candy Tested in Laboratory

TO MAKE sure that the candy we eat is not injurious and that it complies with the pure food laws, hundreds of samples are tested every day in Uncle Sam's laboratory at Washington, D. C.

Mr. J. Hamilton, known as the "candy man" of the U. S. Bureau of Chemistry, is shown at the right analyzing samples from boxes of candy that have been received from the factories.



Molasses Used as Fertilizer in Sugar Fields

MOLASSES is being used with remarkable results as a fertilizer for sugarcane fields on the British island of Mauritius in the Indian Ocean. Increases in yield of about nine tons an acre are recorded after molasses applications. The Colonial Department of Agriculture has made a close study of the experiments and has arrived at a tentative explanation.

When first applied, the molasses partly sterilizes the soil. The nitrification of the soil is suspended and nitrates already in the soil disappear.

When the effects of the molasses treatment wear off, nitrification is resumed at an enhanced rate, and apparently leads to an accumulation of nitrates at a time when they can be utilized best by the growing plant.

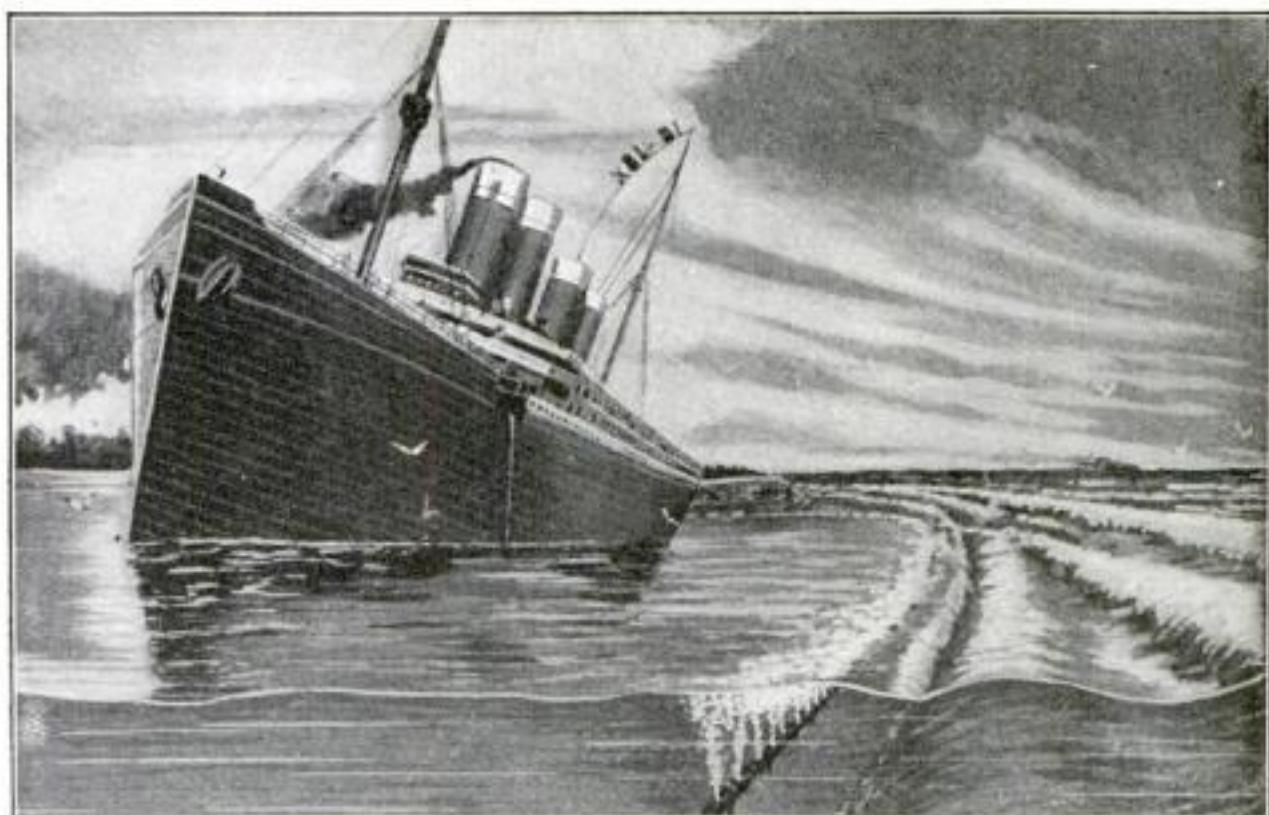
Ammonia and nitrates are said to have a marked tendency to revert to insoluble forms in the soil of the island.

Air Bubbles Employed to Form Breakwater

A NEW type of breakwater consisting of nothing more than air bubbles recently was devised for quieting even the highest waves of the sea. It is the invention of Philip Brasher, an American. One of the units is said to have been operated successfully at El Segundo, Calif., to protect a concrete pier.

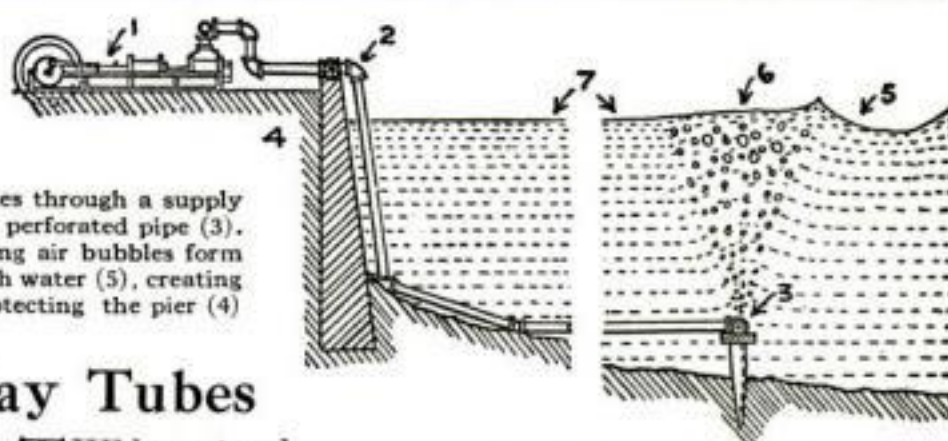
The air breakwater consists of a perforated pipe that is laid along the sea bottom and connected with a land air-compressing station. In rough weather it is merely necessary to allow the compressed air to escape from the holes in the pipe, the air bubbles quickly rising to the surface. The wall of bubbles is said to break up the waves and retard their forward motion. When the water from a broken wave flows back to form a base for the next incoming wave, it finds no support and the next wave curls over and breaks.

The repetition of this process is said to result in a smooth surface beyond the pipe line, no matter how rough the weather. A simple installation of the pipe system, the inventor says, is sufficient to provide a harbor of smooth water in exposed points around coasts that have caused trouble in the past.

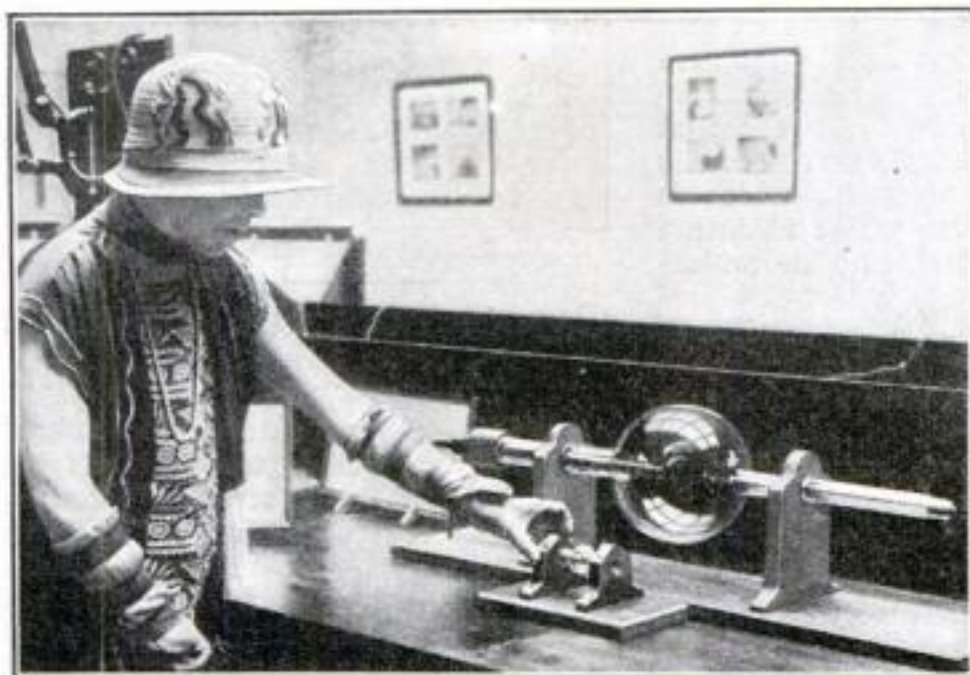


The picture and diagram show how rising air bubbles are employed to break sea waves.

From an air compressor (1) the air passes through a supply line (2) to a submerged perforated pipe (3). Ascending and expanding air bubbles form a barrier (6) to the rough water (5), creating a calm area (7) and protecting the pier (4).



World's Largest and Smallest X-Ray Tubes



THE largest and smallest X-ray tubes recently were placed on exhibition at the National Academy of Science in Washington, D. C. The largest is the most powerful tube ever developed, with 15 times the output of ordinary tubes. The small one is known as an oil immersed dental tube and has a capacity equal to the standard dental tube.

Ship Sails in Milky Sea off Coast of Peru

PLOWING for miles through a milk-white sea was the unusual experience recently of the steamship *Trontolite* off the coast of Peru, as reported by Capt. A. G. Cameron to the Hydrographic Office of the U. S. Navy Department.

This unusual phenomenon occurred at night and, according to the Hydrographic Office, is accounted for by the presence in the water of myriads of tiny plants.

In the account of the voyages of the famous scientific ship *Challenger* is a reference to a similar experience, when the vessel "passed through water full of minute algae gleaming like particles of mica."

Millionth-Inch "Ghosts" Spoil Accuracy of Wonderful Machine

AFTER seven years of futile scientific investigation it was discovered recently that "ghosts" of a millionth of an inch in thickness were the cause of inaccuracies in Rowland's ruling machine at Johns Hopkins University.

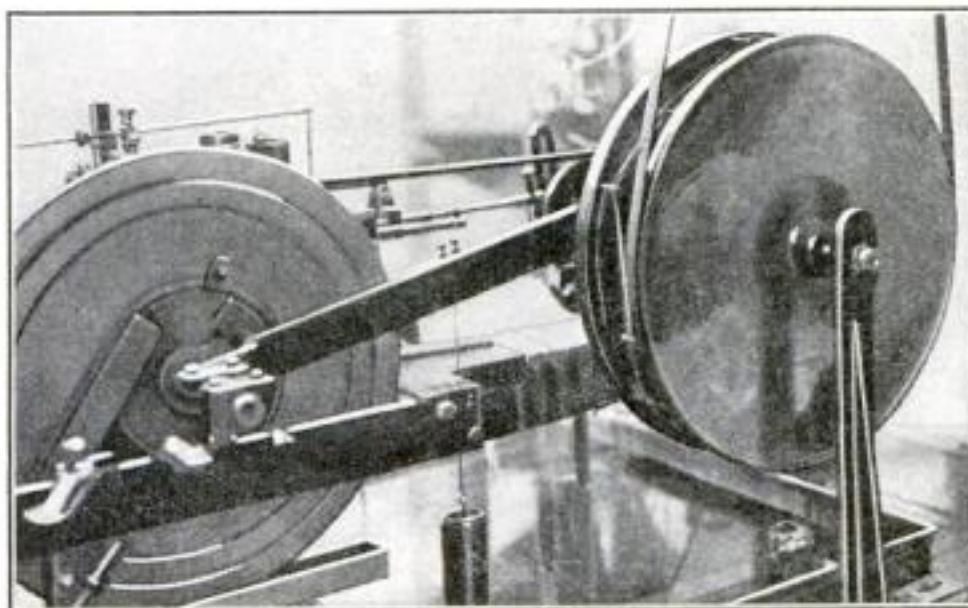
This finely precisioned machine is one of the most wonderful in the world. It is used for ruling lines $1/30,000$ of an inch apart on a metal grating by means of a diamond point. The gratings are used in place of prisms for accurate spectrum analysis.

The "ghosts" were found to be spurious lines in the sun's spectrum, which is the band of color produced when a ray of sunlight passes through a glass prism or a grating.

The "ghosts" in the spectrum were in reality only the shadows of other lines. They made the user of the machine see things that didn't exist. It was found that

periodic vibrations of a millionth of an inch were enough to produce them and the heat of a human body in the same

room also impaired the accuracy of the machine, which now is being used once more.



DISCOVERY of a successful method of eliminating the pain of childbirth without interfering with labor is claimed by Drs. Regina, Perlis, and Gleisz of Paris, France.

The new treatment consists of an injection of a drug said to produce a pleasant sleep lasting from three to five hours, after the manner of "twilight sleep."



Relay System of Pumps Subdues Forest Fires

WHEN the Canadian province of British Columbia was subjected last summer to a continual occurrence of forest fires until over 1000 had been reported, the Parks Commissioner, James B. Harkin, devised a system of water pumps operated in relays that, more than any other agency, assisted the fire-fighters in checking the flames. So successful is the system that the apparatus has been adopted by the entire forestry service, by the railways running through the wooded country, and by lumber companies.

The system comprises a series of rotary pumps, each driven by a gas engine connected directly with the pump and mounted on an aluminum base. The engine is a two-cylinder type with an energy output of from four to five horsepower and equipped with a magneto. Each unit has sufficient power to draw a supply of water through 1500 feet of $1\frac{1}{2}$ -inch hose and to lift it to an elevation of 85 feet with a discharge of 25 gallons a minute. The whole outfit weighs only 360 pounds.

SCIENCE should find a way to make wood and corn husks palatable, and so safeguard against possible future food shortage, according to the statement of Dr. Fritz Haber, of Berlin, Germany.

"Dressing-Chair" for Men Aids Neatness and Speed

THE alarm-clock fails to go off and you wake just 20 minutes before you are due at the office. It is then that you appreciate the work of the designer who has patented a dressing-chair for men, in which there is a proper place for every article of a man's clothing.

It looks like an ordinary chair, but in its back it can hold a man's coat and shirt without wrinkling them. Trousers are placed on the swinging roller just below the top piece of the back; shoes on the side shelves beneath the seat. There is a handy adjustable footrest, which is pulled out in front, in which there are compartments for a shoebrush and whisk-broom.

Your collar, tie, and other small articles find a place in a drawer under the chair seat. This drawer is used for pajamas in the daytime.

A man may undress completely and place every article of his clothing in its proper place without rising from the chair. It costs little more than a plain, straight-backed chair, in spite of its very ingenious design.



The footrest holds the shoebrushes

Removable Hairbrush Is Easily Cleaned

IN CLEANING a hairbrush, usually it is difficult to reach the bottom of the bristles without discoloring handle and back. Here is a brush the bristles of which are set on a detachable pad, which can be slipped out of the back and sterilized in boiling water, if desired.

An additional feature of the brush is the rounded ends of the bristles, which are said to be especially soothing and stimulating to the scalp. The bristles are set in pads in several degrees of flexibility.



Bristles slide off brush back

Coyote Becomes a Menace to Northwestern Farmers

AMONG the predatory wild animals that the Washington State Department of Agriculture is striving to destroy, or at least control, the coyote offers the most serious problem. Notwithstanding a ceaseless campaign against this wily marauder of farm poultry, small pigs, and lambs, as well as countless numbers of game birds, the coyote is increasing and extending his hunting grounds closer and closer to human settlements.

Within the city limits of Seattle, Judge John B. Wright recently clubbed a coyote to death on the road to his court. Coyotes have migrated into the vicinity of Bellingham, Everett, and Aberdeen, localities where their melancholy yodeling had never before been heard. The total damage from the pilfering of these night raiders is said to be enormous.

State Predatory Inspector, Glenn H. Bach, is just now investigating the causes of the rapid spread of the coyote pest. First, he says, is a plentiful food supply; second, the excellent cover provided for the rapid breeding of the wild dogs by the thickly growing cedar, fir, and hemlock covering the hills of the Northwest; third, few state and federal hunters in the Northwestern states.

Next to injurious insects and plant diseases, the coyote is the worst pest now confronting farmers of the Northwest.

Giving the Iceman a Free Hand to Work With

BY COMBINING both handles of an ice-tongs in one, this new tool is easily opened or closed, and can be operated with one hand, according to the designer. It does away with the necessity of opening the tongs before preparing to lift an object.

The tongs is made of alloy steel, well tempered, and may be used not only for handling ice, but also for lifting and lowering boxes, nail kegs, or any hard and heavy article.



Ice-tongs handle is made in one piece

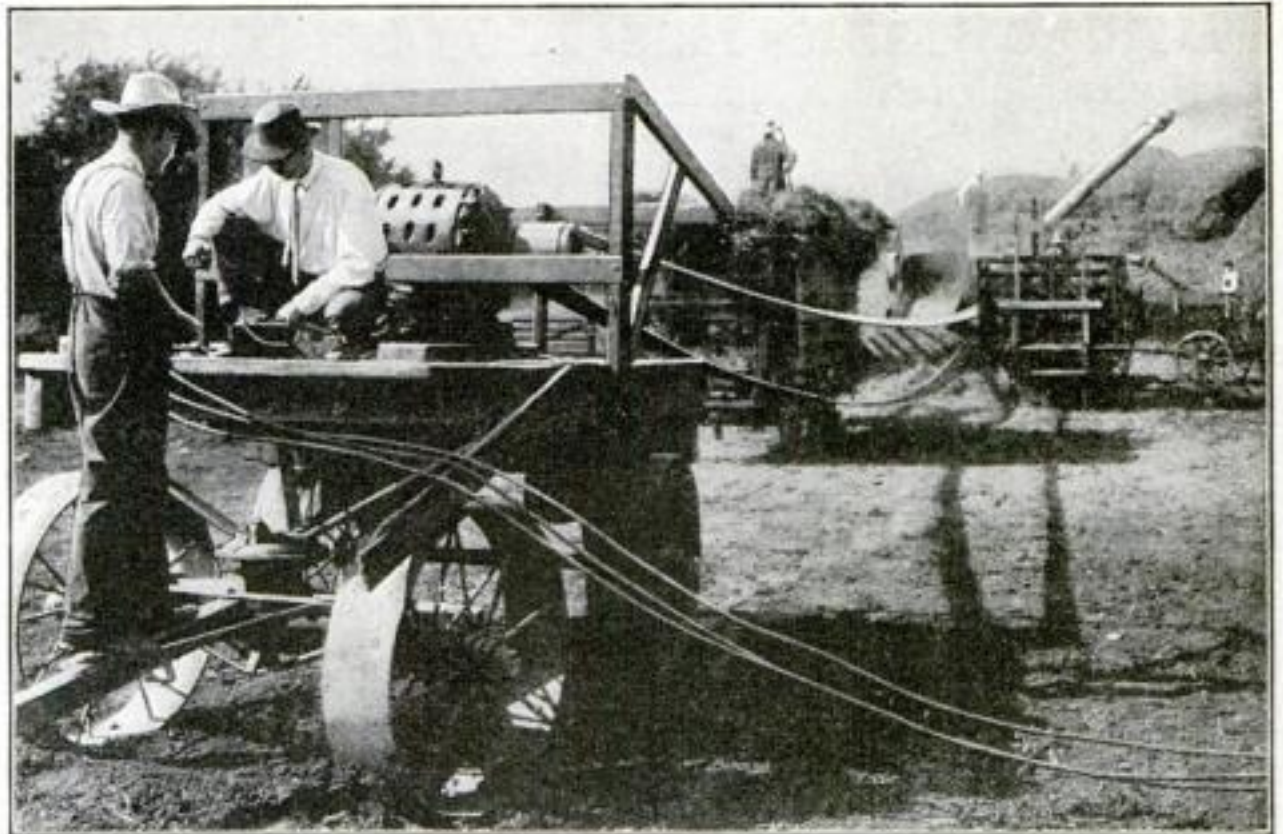
ELEVEN varieties of chestnuts secured from China are now under cultivation by the U. S. Department of Agriculture. It is hoped to secure from these at least one type that will resist the blight that has ruined so much of the United States' chestnut crop. The trees are yet in the seedling stage.

Among them is one which, in Yunnan, produces nuts nearly twice the size of the common American variety. This tree is described as suitable for orchard culture. It grows wild at an altitude of about 8000 feet.

New Spring Will Renew Old Upholstered Chairs

UPHOLSTERED chairs, ready for the junkman because of their sunken seats, may be renovated by attaching a new and inexpensive spring brace introduced recently. It is put on from underneath without disturbing the upholstery, as shown in the illustration at the right, and is said to make the spring seat as plump and firm as ever it was.

Clips are used to fasten the coils to the sides of the chair. If the seat is sagging extremely, it is better, before attaching the spring, to put a little cotton or folded cloth under the seat and, over this filling, place a layer or two of cardboard or corrugated paper.



Motor set-up, showing power lines running from the farm, for threshing by electricity

Threshing Grain by Motor Saves Time and Labor

THE first instance of threshing grain by electricity was on the farm of Eugene Funk near Shirley, Ill., and is said to be a great success. A 40-horsepower electric motor is substituted for the usual tractor for running the separator. The motor is mounted on a truck, and power lines are run from the farm.

The first day the electric motor turned out 133 bushels an hour at a current cost of \$2 an hour. The installation, including motor, transformer, switch, master wires, meter, etc., cost \$1200, about one third that of the traction engine, and half the price of a high-powered gasoline tractor, that is frequently used on farms.

The man in charge of the separator also operates the motor, thus saving the price of a driver.

It is said the daily cost of operation, minus labor, is about the same as that for engine or tractor, but danger from fire is lessened and the trouble of hauling fuel and water is entirely done away with, thus releasing men for other work.



One Movement Opens This Folding Baby-Carriage

SMALL size, light weight, ease of folding, and general convenience are the features claimed by the makers for this collapsible baby carrier, which rolls along on three wheels or may be folded quickly and carried under the arm.

The carriage is made of light, tough wood and the wheels are equipped with rubber tires so that it may be used indoors without injury to the floors of a house. It turns in its own length and has a canvas seat resembling a hammock, which affords the child comfortable and easy riding. The weight of this new car is only 6¾ pounds and one operation folds or opens it.

For those living in apartment houses in large cities, where there is no convenience for baby carriages, this folding car is a boon.



Spring inserted without removing upholstery

Bridge Cable Has 186,666 Strands



THIS six-foot section of wire cable is a sample of that to be used in constructing the huge Delaware bridge running from Philadelphia to Camden, N. J. The cable is composed of 186,666 strands of wire bound with steel clamps and

measures about three feet in diameter.

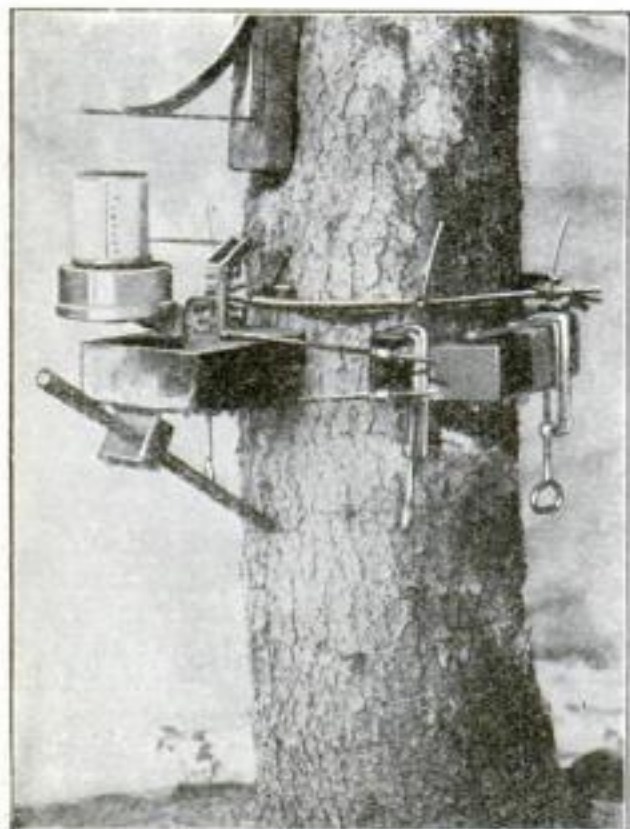
Each foot of the cable weighs several hundred pounds. A power derrick was required to move this six-foot section when it was placed on exhibition at the Philadelphia City Hall.

Daily Growth of Trees Now Recorded on Chart

A NEW instrument, known as a "dendrograph," makes it possible to measure the growth of a tree from day to day. It is adjusted so that it encircles the tree trunk. Expansion of the tree's girth, as well as contraction due to cold weather, are registered on a chart.

One of the instruments recently used by the U. S. Forestry Service at Flagstaff, Ariz., in experiments on Western yellow pine showed no growth on a large tree during 16 days of May, while a small tree recorded growth after the second day. During the summer the large tree showed growth on 88 days, and the smaller on 117.

It was shown that pine has its greatest growth in June.



Apparatus for measuring a tree's growth

Outdoor Sleeping Robe Replaces Blankets

A CHAMOIS interlined back, a high neckband and a hood cape are features of a new sleeping garment designed not only for use by campers, hunters, and tourists, but for persons who prefer to sleep outdoors on sleeping porches all the year around.

The loosely fitting robe is worn over the usual night clothes, and is said to take the place of blankets, and to require one third less bed-covers. An extra length of the garment, which extends below the feet, is closed by a draw cord. The hood is detachable.

The high neck-

band and hood cape are said to prevent colds, neuralgia, and similar troubles caused by exposure of the sensitive nerves at the back of the neck and often complained of by outdoor sleepers.



Substituting for blankets, the sleeping robe provides warmth

Sawdust "Volcanoes" Become Smoke Pests

CITIES of the Pacific Northwest are searching for some way to put an end to a "smoke nuisance" of an unusual kind, resulting from frequent fires in the enormous heaps of sawdust accumulated on old sawmill sites. These fires, which usually are started in spontaneous combustion, send up dense clouds of smoke.

At Leshi Beach in Seattle, Wash., one of these sawdust volcanoes recently renewed its activity after a year of quiet, and its heavy smoke is reported to have driven residents of the district from their homes. City firemen finally subdued the smudge by soaking the crater with water.

In the Washington town of Port Angeles a sawdust pile has smoldered for

20 years, now and then bursting forth in flame and billows of black smoke. At Everett, in the heart of the lumber district, a pile of mill refuse covering an area of 10 acres is a source of constant menace. It has been burning within for 10 years. To remove the pile would require a vast amount of money.

One plan of removal considered by the Seattle city council is the use of hydraulic machinery to loosen and wash away the piles of sawdust refuse into Elliott Bay, an arm of Puget Sound.

Thus far no practical use has been found for old sawdust. The few factories requiring this material demand clean, fresh refuse direct from the mills.

Small Heater for Shower Bath Saves Fuel

BECAUSE of the great scarcity of coal in Germany, hot water has become a luxury. Homes and apartment houses generally have a "hot-water day" once a week for bathing purposes.

In order to make this operation as economical as possible, a German concern is marketing an individual shower heater which is said to supply a sufficient quantity of hot water for a bath from a very small amount of coal in a comparatively short time.

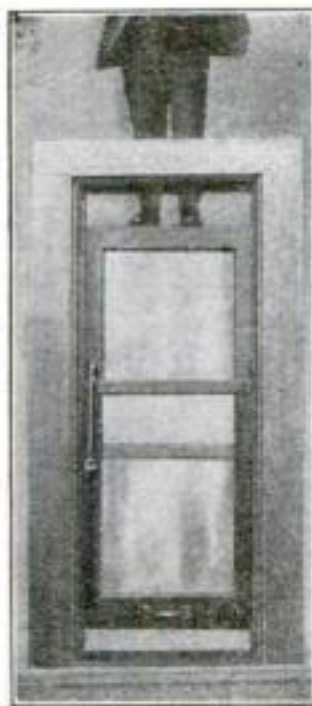
This heater consists of a small special firebox built directly underneath a small water boiler. To this is attached a shower spray and faucet. It is portable and easy to use it is claimed.



Individual heater for the shower bath saves time and fuel

Open Windows Locked by Simple Spring Stop

WINDOWS can be left partly open for ventilation at night without fear of the entrance of burglars, it is claimed, by the use of a new automatic window lock consisting of a simple lever-and-spring stop that binds the two

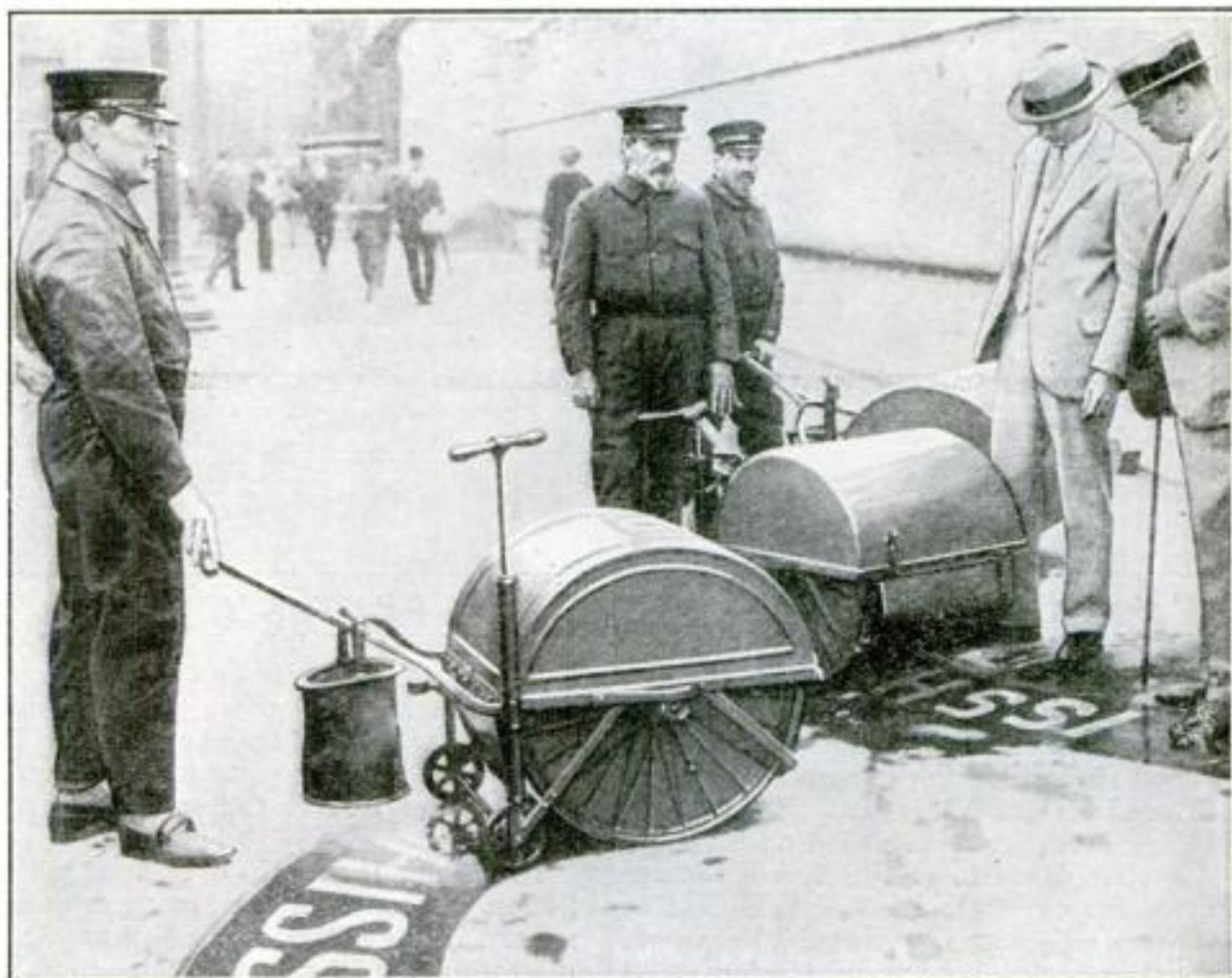


Standing on top of the upper sash to demonstrate the security of the new burglar-proof lock

window-sashes together, whatever position they may be in. This it does so securely, it is claimed, that a man can stand on the top sash without forcing the locked window down to the sill.

The device, fastened with screws to the top of the lower sash, exerts pressure against the upper sash through a lever tipped with a corrugated face. The lock is released by finger pressure on a catch. The locking device will not disfigure a window, it is claimed.

Printing Sidewalk Advertisements



THE latest advertising scheme comes from France in the form of a sidewalk printing machine. The photograph shows

two Americans taking a lesson in sidewalk advertising in the Place de la Concorde, Paris, France.

The machine consists of a revolving cylinder on which large type has been set to spell out the desired words. The type is "inked" with a specially prepared paint in the desired colors. The machine then is rolled over the sidewalk, leaving an advertising sign displayed.

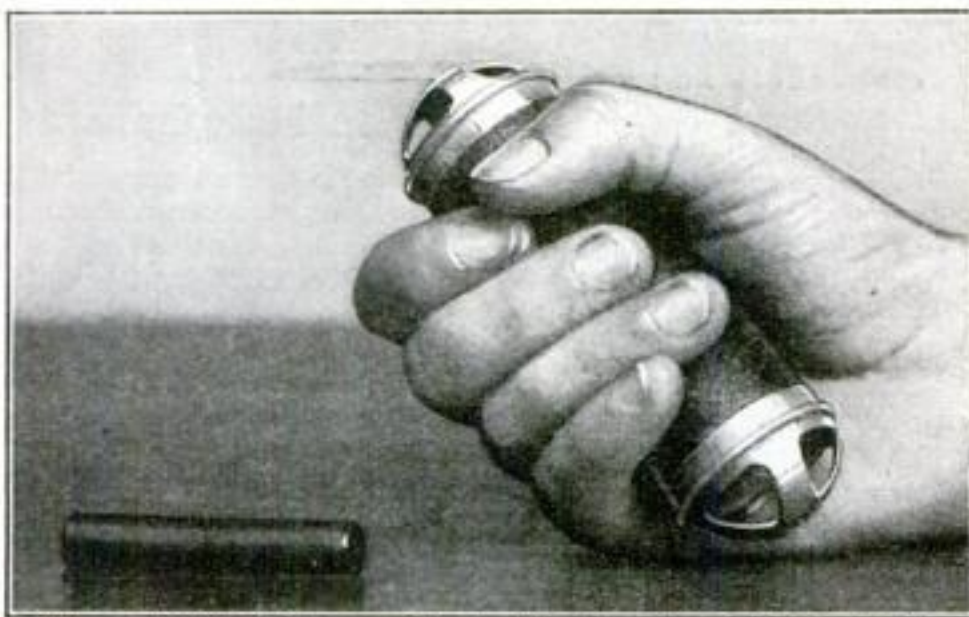
Pocket Charcoal Heater Warms Cold Hands

ONE of the newest inventions for winter comfort is a small hand warmer consisting of a hollow cylinder

of fiber. A small pencil of heated charcoal is inserted through one end. The device will keep warm, it is claimed, for a period of two hours.

To apply the heat to other parts of the body, a wire handle fits into the metal ends and allows the heater to be used as a roller, offering relief, it is claimed, from local aches or pains.

The warmer is small enough for a man to carry it in one of his pockets in cold weather.



The pocket hand warmer, showing also the charcoal heating unit

Speedy Water Buses Will Ply the Thames

THE use of the Thames River in England as a town highway soon will be revived after a lapse of 100 years, according to recent reports from London. By next Easter, it is announced, a fleet of speedy and luxurious motor boats will be running on regular schedules between Hammersmith in southwest London, and Woolwich in southeast London, a distance by water of about 17 miles. It is expected they will relieve some of the congestion of crowded London thoroughfares.

Twenty-five boats will be used, running at 15-minute intervals. Each boat will be 100 feet long and capable of carrying 300 passengers. The boats will be fitted with luxurious conveniences, including writing-

rooms, salons, promenade decks, and restaurants. It is estimated that they will be able to make at least nine miles an hour against the tide.

Since their draft will be only three feet nine inches, and since the landing places will be built well out into the river, the speedy boats will be able to ply in any state of the tide.

Between Hammersmith and Woolwich there will be 25 stations, 12 of which now are ready for use.

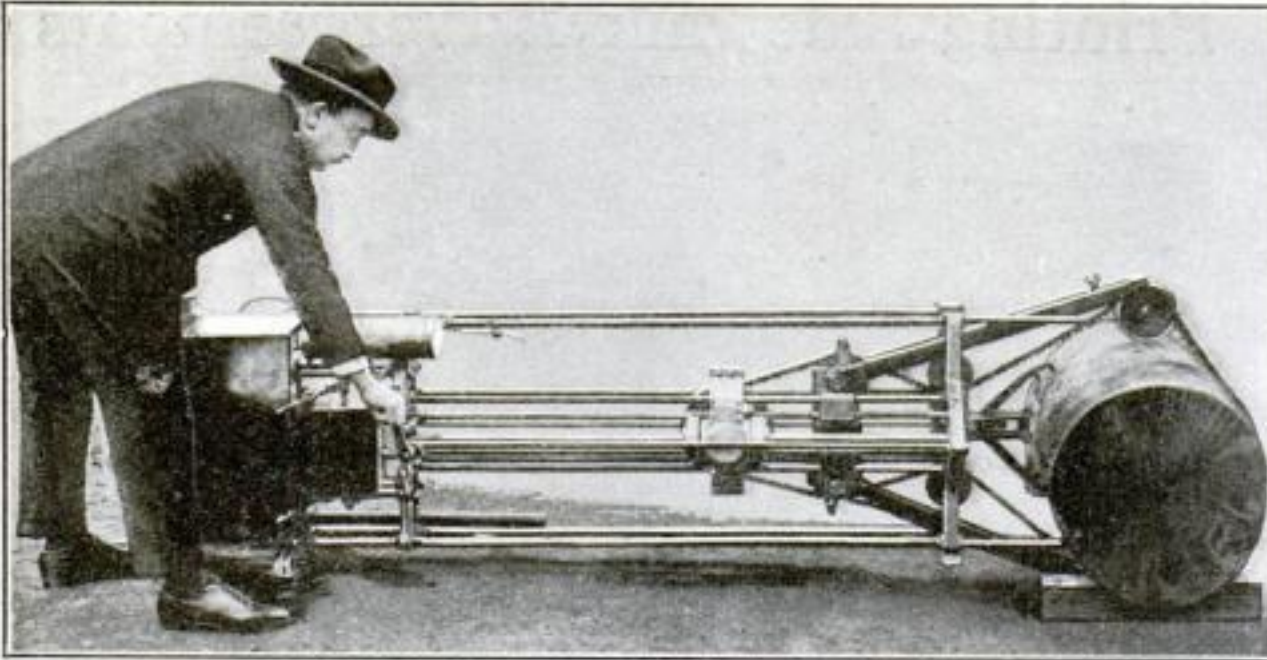
NINETEEN power projects are possible on the Arkansas River in Colorado, with a total potential power of 29,000 horsepower for 90 per cent of the time.

Fighting Barnacle Pests with Colored Paints

THE fouling of the bottoms of ships by barnacles may be greatly lessened as the result of recent experiments with bottom paint by the U. S. Bureau of Fisheries. It was discovered that barnacles collect in large numbers only on blue and black plates, and that white, yellow, red, and green plates are practically free from them.



A ship propeller fouled with barnacles



Chain Saw Speeds Work of Tree-Cutting

AMAZING cutting speed is claimed for a new chain saw invented in France for cutting trees. The cutting apparatus is in the form of a sprocket chain driven by a gasoline engine.

The sprocket is mounted on a frame. A system of worm gearing forces the apparatus away from the tree being cut as the saw works its way through the wood, thus maintaining an equal tension at all times and insuring smooth operation.

The saw is arranged so that it will cut at any angle. The chain, it is claimed, will not get hot or jam when the tree begins to fall. The deep cut it makes is said to force the tree to fall away from the machine.

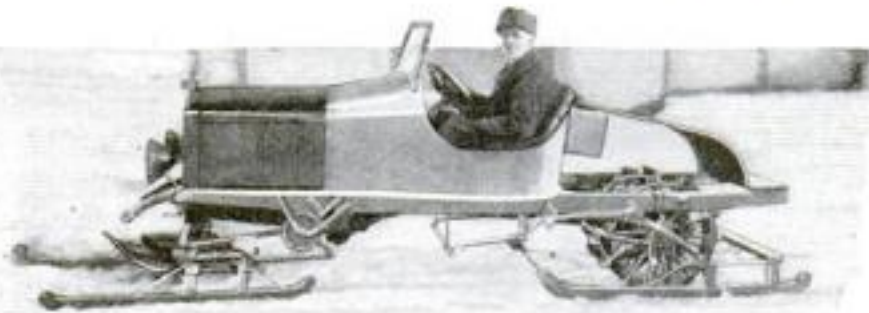
In action, the chain travels at about 20 feet a second. A hard oak tree nearly a yard in diameter is said to have been cut through in from two to three minutes by the use of this chain saw.

He Turned His Automobile into a Sleigh

NOT to be denied the joys of sleigh-riding, Albert Horrocks, of Wilton, Me., transformed his small automobile into the ingenious motor-driven sled pictured below. In place of the wheels he substituted four heavy runners attached to the automobile chassis through springs.

For propulsion he constructed two paddle wheels revolving on a shaft between the two rear runners. These wheels were fitted with strips of metal arranged in zigzag fashion to bite into the snow and provide traction. They are driven, of course, by the automobile engine through crankshaft and gearing.

Two small skis set above the front runners aid in preventing the car from being stalled in snowdrifts. The designer claims his machine can be driven over ice as well as snow.

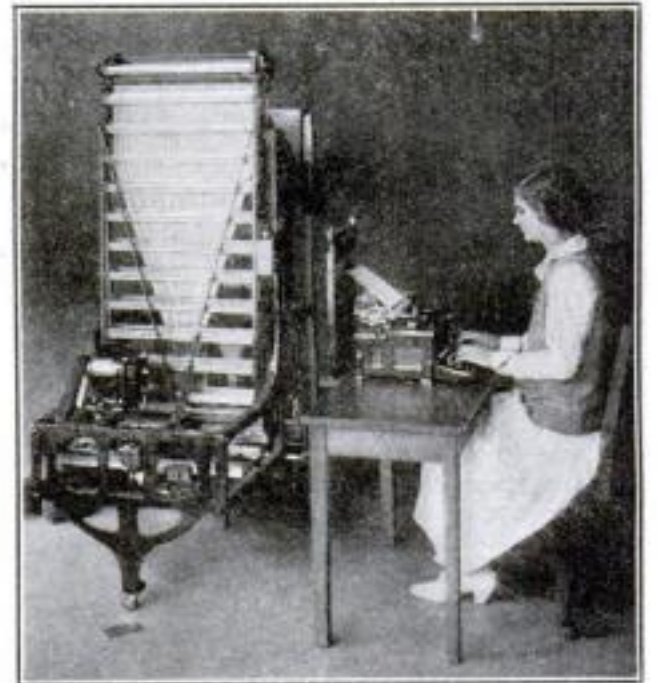


Paddle wheels at the rear drive this motorized sleigh

Stenographer Sets Type with New Machine

A TYPE-SETTING machine that is operated directly from the keyboard of any standard typewriter has been designed especially for use in getting out printed form letters and in the production of books. Thus a stenographer, in writing a letter, sets the type simultaneously. Her typewritten page serves as the proof of the type in the form.

The setting machine is operated by the typewriter keyboard through electrical connections. It is designed so that it distributes used type automatically—an



Setting type with typewriter keyboard

operation that is entirely independent of the type-setting.

The first of the machines are being used successfully, it is said, in a letter-duplicating service shop at Dayton, Ohio.

Barriers to Halt Locusts

TO STOP the ravages of locusts in the agricultural regions of northern Argentina, 39,000 tons of galvanized steel sheets, valued at \$5,000,000, will be used as barriers.

In front of the sheet-steel barriers the farmers will dig ditches in which, it is expected, the marching locusts will accumulate and be destroyed.

Gilded Goggles to Save Workers' Eyesight

GOGGLES of gilded glass, consisting of yellow glass with a coating of gold, recently have been invented by Dr. A. H. Pfund, associate professor of physics at Johns Hopkins University, to protect the eyes of workmen who are exposed to the intense glare and heat from furnaces. The glass is said also to be useful as a safeguard against fire in the handling of motion-picture films.

The gold-coated glass is said to eliminate the heat and glare from light, while permitting sufficient illumination for clear vision. The gold passes the light waves on to the eyes, but casts off the heat waves and ultra-violet rays.

As applied to motion pictures, the invention makes it possible to stop a film that is being run off and to examine an individual picture closely without danger of the film's catching fire.

Sled Trailer Aids in Winter Log Hauling

THIS easily made sled trailer enables a truck to transport an unusually large and heavy load over winter roads. It was built by a Minnesota lumberman who

refused to allow snow-covered roads to interfere with his hauling.

The truck and sled shown carry a 10-ton load of 70 20-foot logs.



Hauling logs over the snow in Minnesota with the aid of a sled trailer, which will carry 10 tons

Three Persons Ride on Tandem Bicycle

A GERMAN inventor has come out with a new form of tandem bicycle that carries an extra person on a platform between the two machines. The contrivance, called a "combi-bicycle," consists of two bicycles attached in parallel, with a platform and seat suspended between them. This platform is slung from a light frame connecting the two bicycles.

The pedaling is done by both riders, and the front wheels are connected in tandem so that if the machine is operated by only one driver the steering may be



Tandem bicycle riders with a passenger

done as if there were only one wheel. This strange contrivance is shown before the famous Brandenburg gate in the city of Berlin.



Highways Repaired by Electric Machines

A NEW type of electric power machine for road-repair work recently has been put to use in France. It is mounted on a two-wheel carriage and pushed like a wheelbarrow. An electric drill bores

holes in the road to be broken up, then a forklike arrangement digs away the cement.

Power is obtained either from a portable dynamo or from electric trolley wires.

Wheelbarrow and Cart Combined

FOR use on farms, or wherever heavy and bulky objects, such as milkcans, are transported by hand, a new double-duty wheelbarrow has been designed so that it can be used either as an ordinary barrow or as a small, underslung cart.

The height of a wheelbarrow causes unnecessary labor in lifting heavy milkcans into it. For this reason the new device is arranged so that it can be converted into a low cart simply by turning it upside down. This is accomplished by means of a movable bottom that can be attached readily at either of two opposite sides of the wheelbarrow frame.

The wheelbarrow converted into a low, underslung milkcart. This is done simply by turning the wheelbarrow upside down and transferring the movable bottom from one side of the frame to the other



New Electric "Matches" for the Motorist

TWO new types of "electric match" for the motorist who smokes while he drives, are shown below.

One model is detachable, with the lighting instrument on a cord that reels



Above is a stationary cigar lighter on the instrument board. At the right is a lighter attached to a lengthy cord that is unwound from a reel

into a container on the car's dashboard.

The other model is permanently attached to the instrument board or any other part of the car, with an ash receiver attached below. The heating element is in the center, protected by a movable cover that is pressed in with one finger while the cigar is held in position for lighting.



Science Learns how Plants Manufacture Sugar

SCIENCE at last has succeeded in making sugar in a way similar to that in which the green leaves of plants have been yielding it for countless ages.

The discovery of the process was made by Dr. E. O. O. Baly, senior professor of chemistry in the University of Liverpool, England. In a recent demonstration before a meeting of the sugar chemistry division of the American Chemical Society, he described the methods by which science can imitate the intricate processes of plants in converting the carbon dioxide from the air and water from the ground into sugars and proteins.

Doctor Baly worked on the theory that the chemical reactions in plants are due to the absorption of quantities of energy from the sun's rays, and that the first reaction is the uniting of carbon dioxide and water to form formaldehyde.

By exposing carbon dioxide and water to the intensely active ultra-violet light from a quartz-mercury vapor light, he was able to form slight traces of formaldehyde. He discovered, too, that the formaldehyde immediately formed sugar. The reactions, he pointed out, require tremendous amounts of energy.

Last Scrap of a Battleship

AT THE right, workmen are shown removing the last remnant of a great ship that never even reached the water—the last steel beam to be cut from what remained of the battleship *South Dakota*, scrapped by Uncle Sam. This and a sister ship, the *Indiana*, now would be the latest additions to our battle fleet, if, in the course of construction, they had not been doomed, in accordance with the Washington Disarmament Conference.

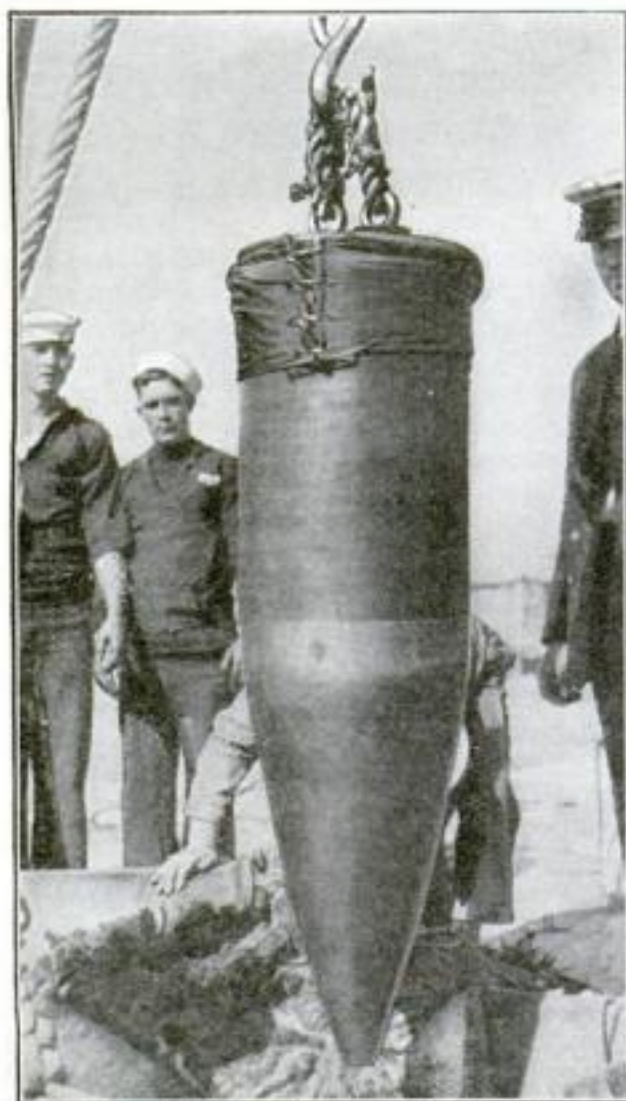
The work of scrapping them was begun November 13, 1923. Two hundred and five working days were necessary to cut both ships to pieces. The work was done at the Brooklyn Navy Yard.

Giant Shell Used in Navy Target Practice

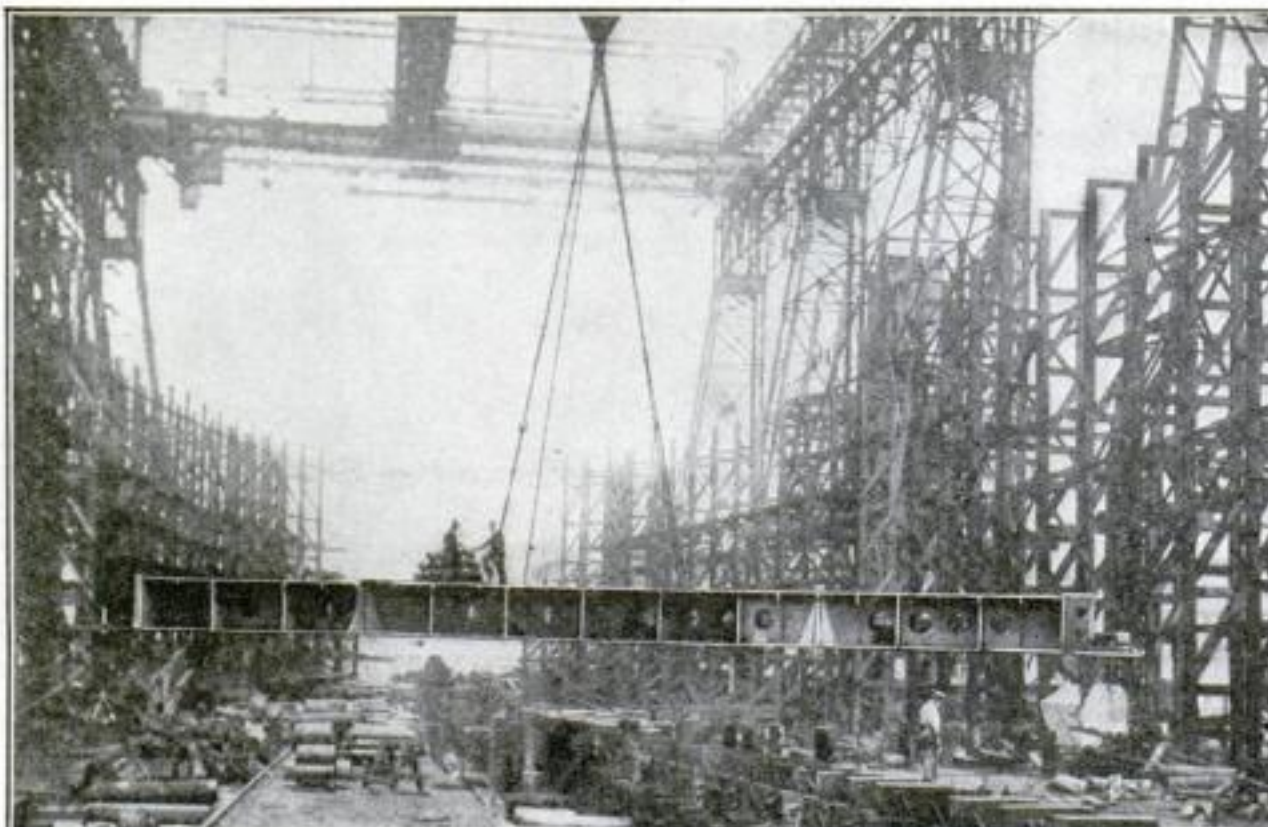
ONE of the giant shells used in target practice by battleships of the U. S. Navy in their maneuvers this fall is shown in the photograph below.

The shell is 14 inches in diameter and weighs several hundred pounds. The big guns can hurl this mass of metal a distance of more than 20 miles.

Jackies are shown in the illustration below with block and tackle, about to stow it away on board the *Pennsylvania*.



Huge shell used for target practice



Removing the last steel beam in scrapping the great battleship *South Dakota*



Odd Four-Seater Driven like a Bicycle

AN ODD foot-power automobile, driven like a bicycle, on the chain-and-sprocket principle, recently has been invented by Monsieur Alois Seuter of Neuilly, France.

The new machine, which he calls a "Velo" car, seats four people and has a compartment for carrying packages. The designer says he can attain a speed of about five miles an hour with good pedaling. The body is made of light woodwork. The car is steered by means of ordinary bicycle handles.

Tests in Left-Handedness

AS THE result of comparative intelligence tests with right-handed and left-handed individuals in a group of 1019 children, Dr. Kate Gorday, a psychologist of Los Angeles, Calif., recently announced she could find no confirmation of the tradition that left-handed persons are of inferior mentality.

She concluded, however, that among subnormal individuals there probably is a large percentage of left-handedness. She found, too, that there are more left-handed boys than girls, and that left-handedness runs in families.

Fish Found in Desert

SPECIMENS of fish that swim beneath the sands of the Sahara Desert are among the latest curiosities to be exhibited at the American Museum of Natural History, New York City. They were taken from subterranean desert water pools, and are not of rare species, as might have been expected.

One kind is a member of the minnow family. Others resemble perch.

The presence of these fish in the desert remains a

mystery. One theory is that the eggs are transported there in particles of mud or weeds carried in the claws of birds that visit the desert water holes.

Wooden Giraffe Formed by Junction of Trees

IN THE village of Munsonville, N. H., nature, in one of her playful moods, formed a strikingly realistic reproduction of a giraffe by the junction of two trees that grew together. The dual trunk of one tree formed the legs of the "animal," while the twisted trunk of a second tree, which grew about four feet away, joined the legs and stretched upward like the long neck of a giraffe.

The only artificial work done on it was the chiseling out of the eyes and mouth in order to give the wooden creature a definite expression.

This curiosity is located outside the village general store and is the object of much attention from passers-by.



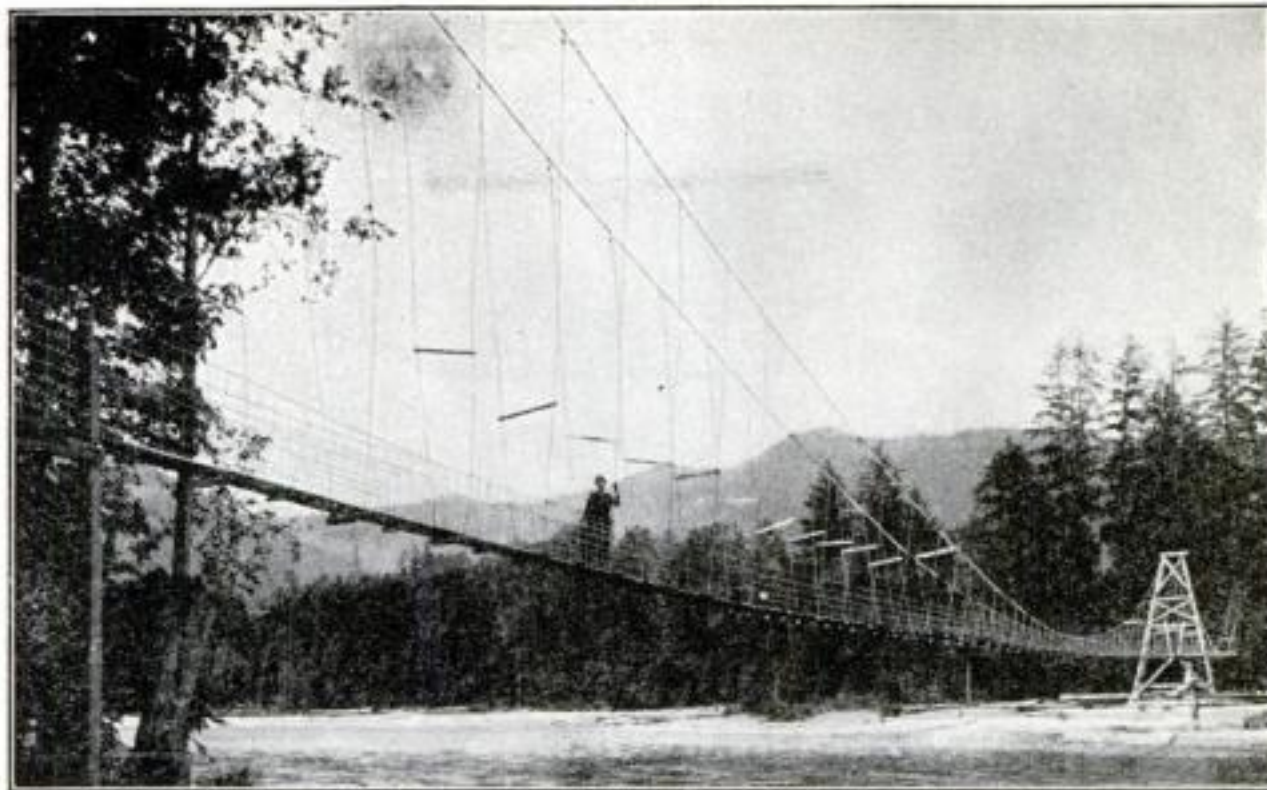
Wooden giraffe—a freak of Nature

Bridge Hung from Trees

WHAT is said to be the longest suspension foot-bridge in the world stretches across the Quinault River on the Olympic Peninsula, Washington. The bridge is 994 feet long and only two feet wide.

The end supports are big fir trees growing on each side of the river. From them the wire cables carrying the bridge walk are stretched. These cables are supported also by a center pier 54 feet high, resting on a mat of rocks and branches. Overhead cables to which the bridge is attached prevent side-sway.

The bridge was constructed for the use

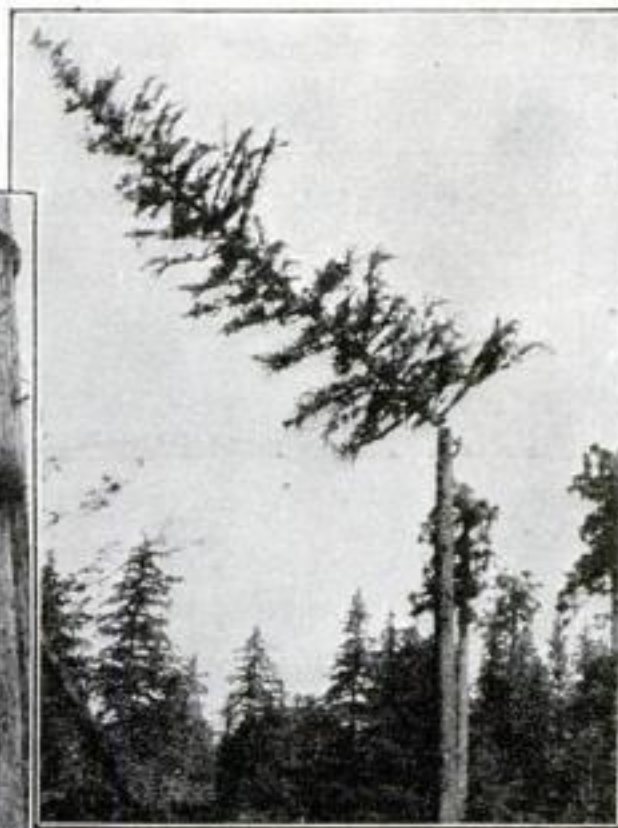


This narrow suspension footbridge across the Quinault, Wash., is slung from giant trees

of farmers, and is their only means of crossing the river other than by boat, an impracticable task when the spring freshets are running high.

World's Champion Tree-Climber at Work

CUTTING trees in midair is the spectacular occupation of W. H. Hamilton, a logger in the forests of Washington State, who recently won the title



The unusual photograph above shows the falling top of a tall fir tree, just after it was cut. The cutter may be seen immediately below the break. At the left is W. H. Hamilton, champion tree-climber, descending a 100-foot tree. His saw is tied to his foot to leave his hands free

of world's champion tree-climber by scaling a 100-foot Douglas fir tree, cutting off the top, and returning to the ground—all in 18 minutes.

In scaling a tall tree, Hamilton wears climbing irons similar to those used by telephone linemen, with which he gets a foothold on the tree trunk. In addition, he carries a stout rope, one end of which is fastened to his belt. He slings the rope about the trunk and holds the other end with his right hand. By these means he pulls himself upward or lowers himself.

During the ascent and descent his saw is tied to one foot to allow him free use of his hands.

To the layman, such a "human fly" per-

formance appears very dangerous. In fact, it is somewhat risky, but the expert climber in a logging crew enjoys the thrill.

Fir trees, such as those shown in the photographs, form the basis of the lumber trade of the Pacific Northwest. Much of this lumber passes through Seattle and Portland.

Highest Telephone in U. S.

THE highest telephone in the United States is located on the summit of Pike's Peak, in Colorado—an altitude of 14,110 feet, or nearly three miles. It is on the property of the Pike's Peak Highway Association.

Relics of a Lost Race

DISCOVERY of the remains of an ancient race that once inhabited the lonely Island of Nihoa in the South Seas, about 250 miles northwest of Honolulu, is reported by members of a recent exploring expedition that went there aboard the U.S.S. *Tanager*.

Evidences of human habitation included acres of garden terraces, home sites, implements, and an infant burial place. Many of the

house sites were excavated.

Among the relics discovered were ancient bone needles that may have been used for tattooing or sewing, and one odd fishhook made of human bone. Grindstones showing much wear, and polished sharp stone adzes also were unearthed.

Necker Island, 150 miles away from Nihoa, showed traces of ancient visitors, but nothing to indicate actual habitation.

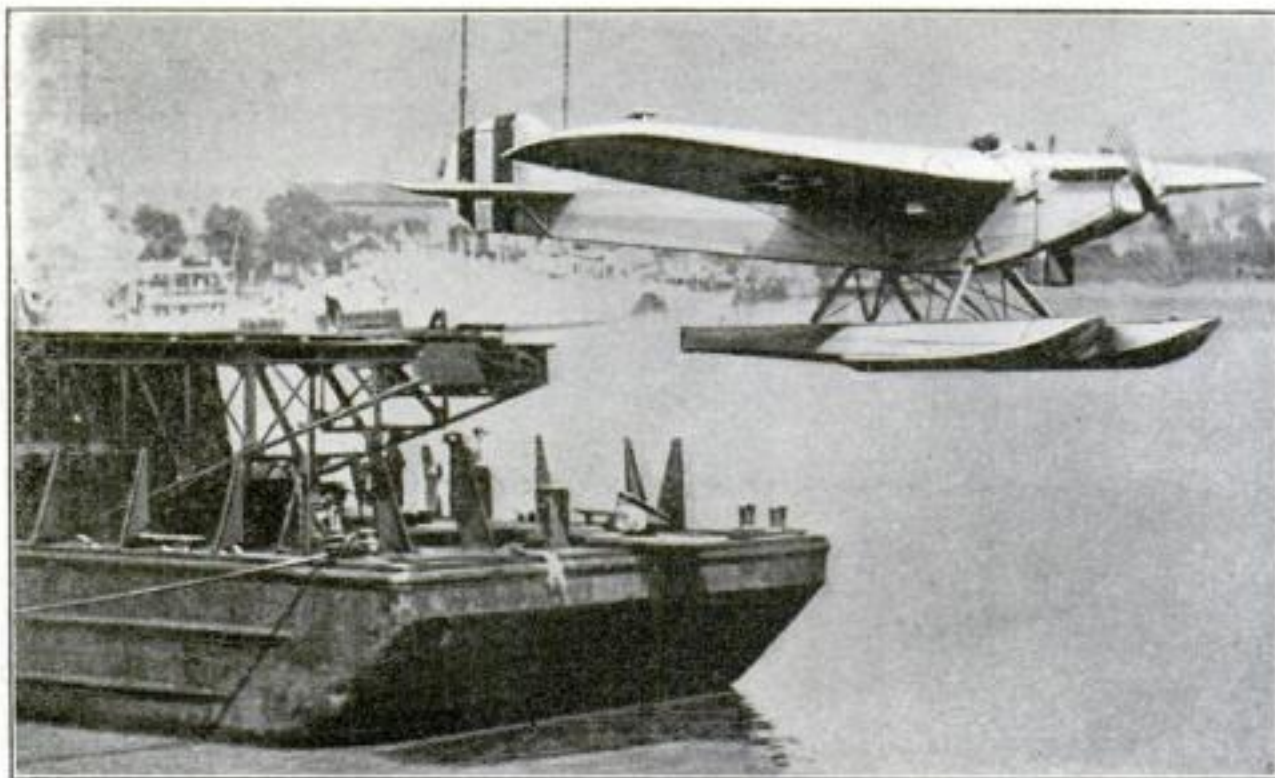
Small Propeller Adds New Thrills to Skiing

MOTORIZED skiing is a novel sport recently made possible by means of a small air propeller driven by a light motor that is strapped on the back of the skier. The invention, from Germany, is said to enable an experienced skier to travel on the level at high speed.

The propeller is started and stopped by a pneumatic device similar to that which opens a camera shutter. The motor has one cylinder and resembles an outboard canoe motor.



Motor and propeller strapped to skier's back



Planes Now Shot from Ships by Gunpowder

SHOOTING airplanes from a ship into midair by means of a gunpowder catapult is the newest achievement of the U. S. Navy. Instead of compressed air which is usually used in airplane catapults, gunpowder is employed to give the plane its start.

The new catapult gun contains a piston connected through a series of multiple pulleys with a small wheeled car. This

runs on a track about 50 feet long. When the powder charge is fired, the piston, acting with the pulleys, hurls the car forward at a speed of about 60 miles an hour, thus throwing the airplane into the air at a speed great enough to start it on its flight.

The photograph above shows a navy seaplane taking the air by this method of propulsion.

Navy Flier Sets New Speed Record for Seaplanes

STREAKING through the air at 197.6 miles an hour, Lieut. George T. Cuddihy, U. S. N., recently smashed the American seaplane speed record in tests above the Delaware River.

Lieutenant Cuddihy's speedy plane is a 500-horsepower CR-3 machine that won the Pulitzer Trophy in 1920 as a land plane. Now, equipped with pontoons, it has demonstrated its ability to rise from the water and to cover $2\frac{1}{2}$ miles in a little less than 60 seconds. The upper plane of the machine is of brass and forms a radiator.

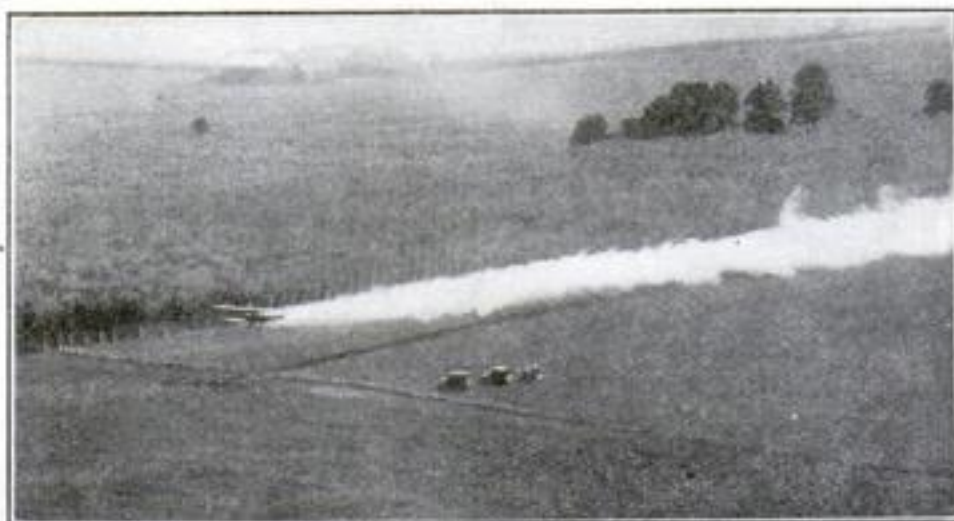
Another seaplane piloted by Lieut. Ralph A. Ofstie, nearly equaled Cuddihy's record, flying at 190 miles an hour.

The world's record is claimed by a British seaplane, at 220 miles an hour.

Fighting the Boll Weevil from the Air

THE airplane is the latest weapon to be employed in Texas in the war on the boll weevil, arch foe of cotton. Cotton-fields now are dusted with calcium arsenic sprayed from a plane as it sweeps by just a few feet above the tops of the plants.

Similar dusting formerly was done by ground machines, but several advantages are claimed for the new and more spectacular method,



An airplane dusting Texas cotton-fields with calcium-arsenic spray

chief of which is, perhaps, that the plane can start dusting immediately after rain, the most advantageous time to fight the weevil. Ground machines are forced to wait until the ground has dried.

The rapidity of plane spraying is another advantage. One plane can dust an average of about 200 acres an hour at a cost of about 30 cents an acre.

A third advantage claimed for the new method is the fact that the plane does not touch the plants and so damage them. Ground machines always break off a certain quantity of cotton bolls and squares.

The fourth advantage is probably the most interesting. Spreading the poisonous dust grains by airplane causes them to stick to the plants better, because when these grains are shot through the air at high velocity, they retain a positive charge of electricity from the air. The cotton plant contains a small charge of negative electricity. When the two come in contact, they stick closely because of the attraction of the opposite charges.

Flying "Window Shutter" Built in France



ONE of the most unusual of the new developments in airplane construction is a machine shaped like a window shutter, with 21 narrow lifting surfaces or wings sheathed with aluminum. It was designed by M. Toussaint, a French engineer, and constructed at the great flying-field at Villacoublay. It is driven by a 30-horsepower motor.

Altitude Test Chamber Is Made Safe by Valve

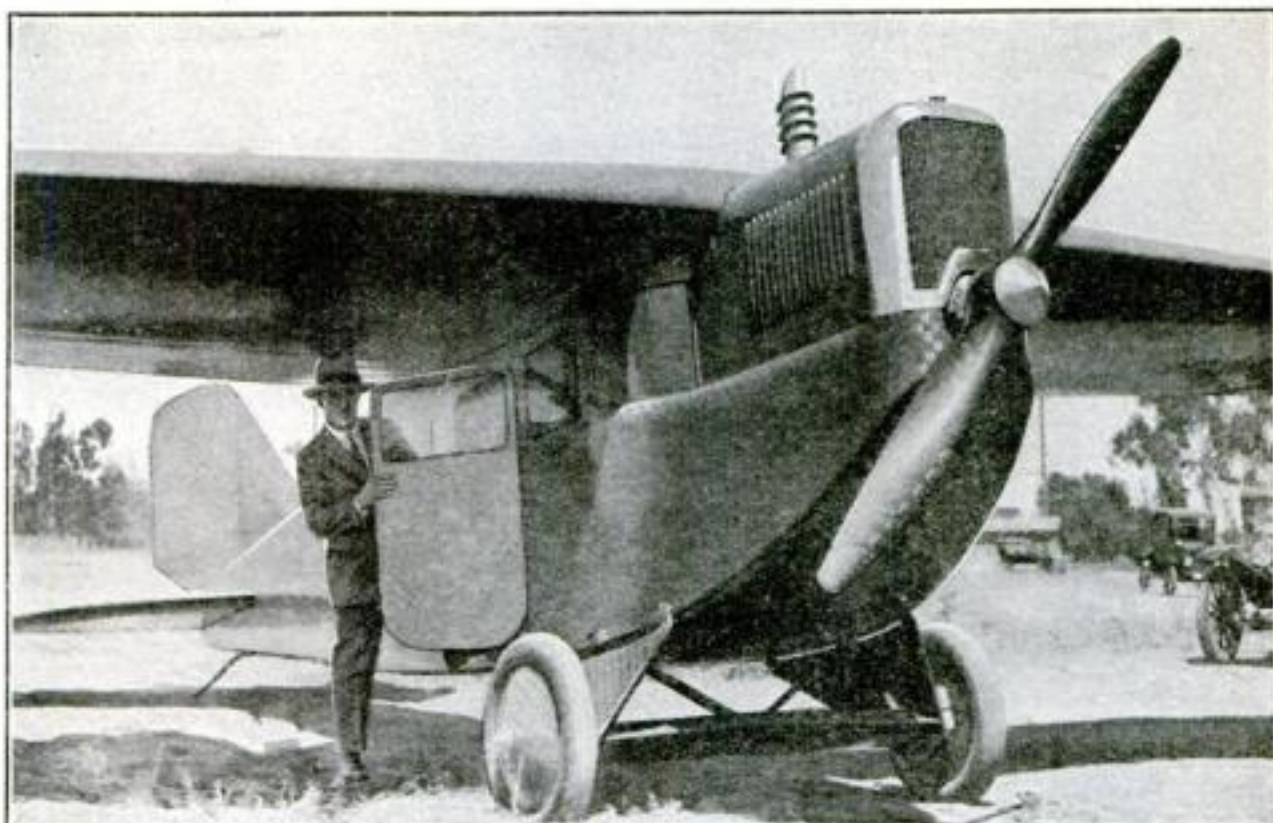
A NEW altitude chamber with a safety-valve device has been constructed at the U. S. Bureau of Standards for testing airplane engines in rarefied atmosphere such as is encountered at high altitudes.

An explosion occurred a year ago in the chamber previously used, resulting in the deaths of three men.

To attain the required results the vault must be sealed tightly and the air pumped out. Nobody remains in the chamber when the test is under way, and the air often becomes laden with gasoline vapor that may be set off by a stray spark or backfire from the motor.

The safety valve consists of a rear wall of light material that will be blown out of the back of the building in case of an explosion.

This specially constructed wall is made to stand considerable pressure from outside, but will blow out if the pressure inside is increased two pounds a square inch. In case of an explosion, this wall will be blown out of the back of the building, where concrete partitions will prevent flames from reaching the operators. By this means it is expected that the tests by the bureau can be continued in entire safety to the operators.



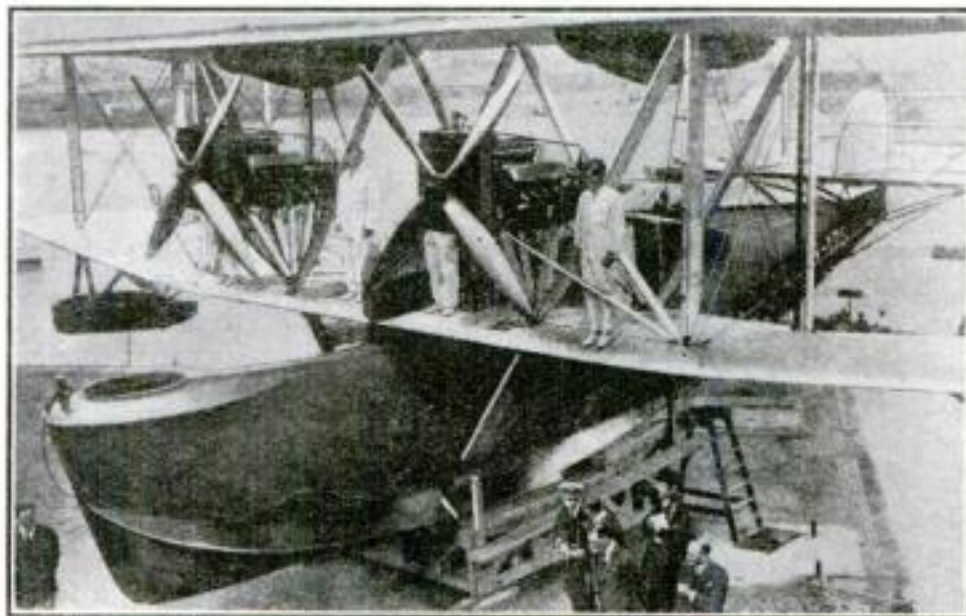
Monoplane Limousine Last Word in Luxury

WHAT is said to be the last word in airplane luxury has just been constructed in the form of a passenger-carrying monoplane built by its designer, Osmund T. Belcher, of Los Angeles, Calif.

The new ship has four inclosed cabins and weighs but 1800 pounds. It is

claimed the craft can carry 107 per cent of its own weight. It is 41 feet wide, 27 feet long, and nine feet high. It can rise 1000 feet a minute, the designer says. Entrance to the comfortable and well upholstered cabins is gained easily by means of the door on the side of the body of the machine.

This Huge Seaplane Carries 12 Passengers



The new 12-passenger supermarine plane in drydock in England

Oehmichen Sets Record for Helicopter Performances

A WORLD'S record for helicopter lifting flight recently was established at Montbeliard, France, by Etienne Oehmichen, French airman and pioneer in vertical flight, when his machine succeeded in lifting a dead weight of 200 kilograms, or about 440 pounds, to a height of one meter (about a yard). In his first attempt he lifted 100 kilograms, then increased this weight to 175, and finally to 200.

By this feat Oehmichen won a prize of 40,000 francs for successful performance. It will be recalled that previously he established several records for helicopter flight.

In tests last April Oehmichen flew 575 meters (about 1700 feet) in a straight line, but was later outdistanced by Pescara, who flew 838 meters, the equivalent of about 2700 feet.

WHAT is said to be the only airplane in the world without a tail is a novelty recently completed at the French military airdrome at Villacoublay. The unusually large rudder is placed immediately behind the wings of the airplane.

Standing beside the machine is M. Jaugin, famous French airman, who claims the world's speed record as a hydroplane pilot.

The Only Tailless Plane in the World



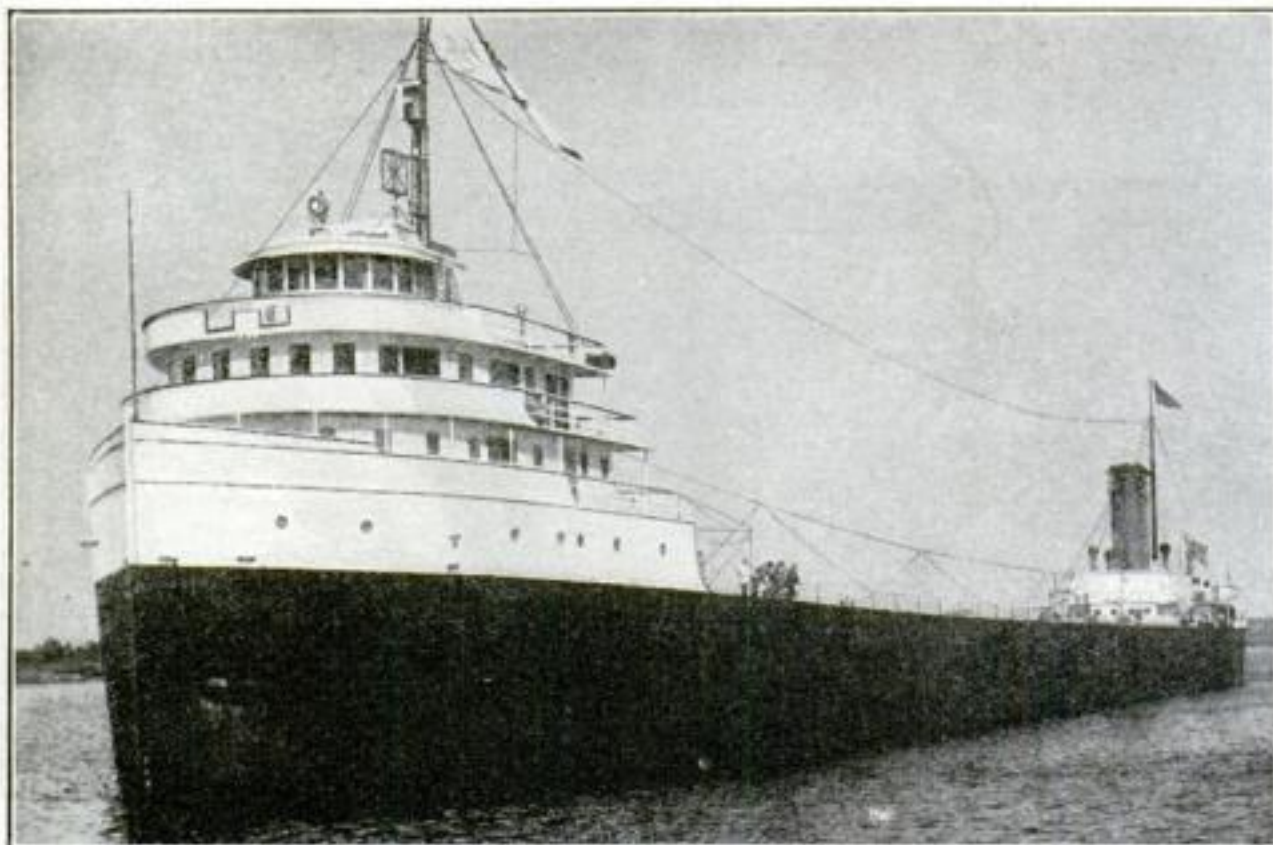
This unusual looking plane carries its rudder close to its body

French Hunter Gets His Shells by Airplane

A WORLD'S record price for shotgun shells was paid recently by a French millionaire sportsman and senator, who had the shells shipped from Paris to Scotland by airplane. Each shell cost him 20 francs, or about \$1.10.

On his hunting trip in Scotland, the senator carried shotguns of a special make, and when he reached his destination he found that he was unable to obtain ammunition for this type of gun. So he hired an airplane and dispatched his secretary to bring him some shells.

The plane left Scotland in the morning and arrived at Le Bourget in the evening. The following morning the secretary bought 1000 shells in Paris and returned to Scotland that evening.



First Diesel Freighter for Great Lakes

FOR transporting coal and ore from the mines of Minnesota to the Ford automobile plants in Michigan, Henry Ford has constructed the first of a fleet of 600-foot Diesel freight boats, which will ply the Great Lakes. The photograph shows the *Benson Ford*, the first one to be launched, when it was passing through the canal at Sault Ste. Marie, Mich., bound

for the city of Detroit, loaded with coal.

The ship cost \$2,000,000 and is said to be one of the finest and most modern freighters ever built. It is fitted with radio and radio compass.

If the operation of these freight lines proves as successful as expected, it is reported that Ford may branch out into ocean-going trade.

Sixty Upside-Down Sloths Arrive in America

TO BE upside down usually is considered upside down, but with a sloth, upside down is right side up. This queer animal is a native of South America. It lives in trees, hanging from the branches by means of its long, curved claws. It never leaves a tree until it has stripped it of every leaf, then it travels over the branches to another, descending as seldom as possible.

On the ground it is practically helpless, because of its slow and apparently clumsy movements, from which it derives its name. This slowness is due to its disproportioned structure, but most particularly to the fact that its feet turn in awkwardly.

Sixty of these creatures recently arrived in San Pedro, Calif. They were captured by Cecil B. Wright, and they constituted the second group of sloths to reach this country in the last 35 years.



The clumsy sloth lives upside down



Historic Palm Tree Moved across a City

THAT a tree is never too old nor too tall to be moved was demonstrated in Los Angeles recently when a large date-palm tree, planted in 1786, was bodily removed from the ground, transferred across the city, and replanted. The reason for preserving the tree in this manner when the plot on which it stood was needed for building was the fact that it is of historical value.

It is estimated that the tree weighs 60,000 pounds. It stands 80 feet high, and two derricks were required to move it. The photo shows the tree being removed from its original site.

Odd Petrified Wood Block Mysteriously Carved

A STRANGE oddity recently discovered in the pine forests of Louisiana has everybody guessing, scientists as well as laymen.

It is a piece of petrified wood about two feet square and weighing 103 pounds, carved into an elaborate and intricate series of designs, including—at least to the imaginative—flowers, animals and human faces. There is not a square inch of the surface that is not carved or chased.

This block of petrified wood, weighing 103 pounds, is completely covered with strange figures carved in some manner as yet unexplained



One scientist who has seen it expressed the belief that carpenter ants did the work, but, if they did, it is a unique production, for nothing like it ever before has been found. At first, there was a suspicion that human ingenuity was responsible for the freak, but that theory was abandoned, because of the immense labor involved, and the apparent aimlessness of the energy expended.

The curiosity was found under a fallen tree in LaSalle parish. It is owned by Baker Thomas of New Orleans.

Oldest Stone Buildings Found in Egypt

THE world's oldest stone buildings are reported to have been discovered recently near the famous pyramids of Sak-kara, about 15 miles south of Cairo, Egypt. They are two royal tomb chapels of the third Egyptian dynasty, about 4000 B.C.

Built in a style differing in almost every respect from what is known as Egyptian architecture, the chapels are believed to have been the burial places of princesses or queens. Fragments of gravestones of royal princesses are reported to have been found near by archeologists who have been digging on the site.

Fluted columns with leaf-form capitals decorate the façades of the chapels, while the side walls have the earliest known form of papyrus capital and column seen in the world's architecture.

Wheeled Parcel Carrier to Aid the Shopper

THE latest European novelty for carrying heavy parcels is a small detachable wheel to which is fitted a collapsible frame. The entire outfit can be carried in the pocket.

For carrying large bundles homeward, it is necessary merely to attach the wheel to the end of one's walking-stick or umbrella. The result is a small car or framework capable of transporting as much as 50 pounds, according to the inventor, William Helfrich.



This small wheel, attached to a walking-stick or umbrella, is designed to aid the shopper in carrying home extraheavy bundles

African Bird Enlists Men to Open Beehives

ONE of the cleverest birds in the world is the "honey guide" of Africa, which has learned to entice men to open beehives for him.

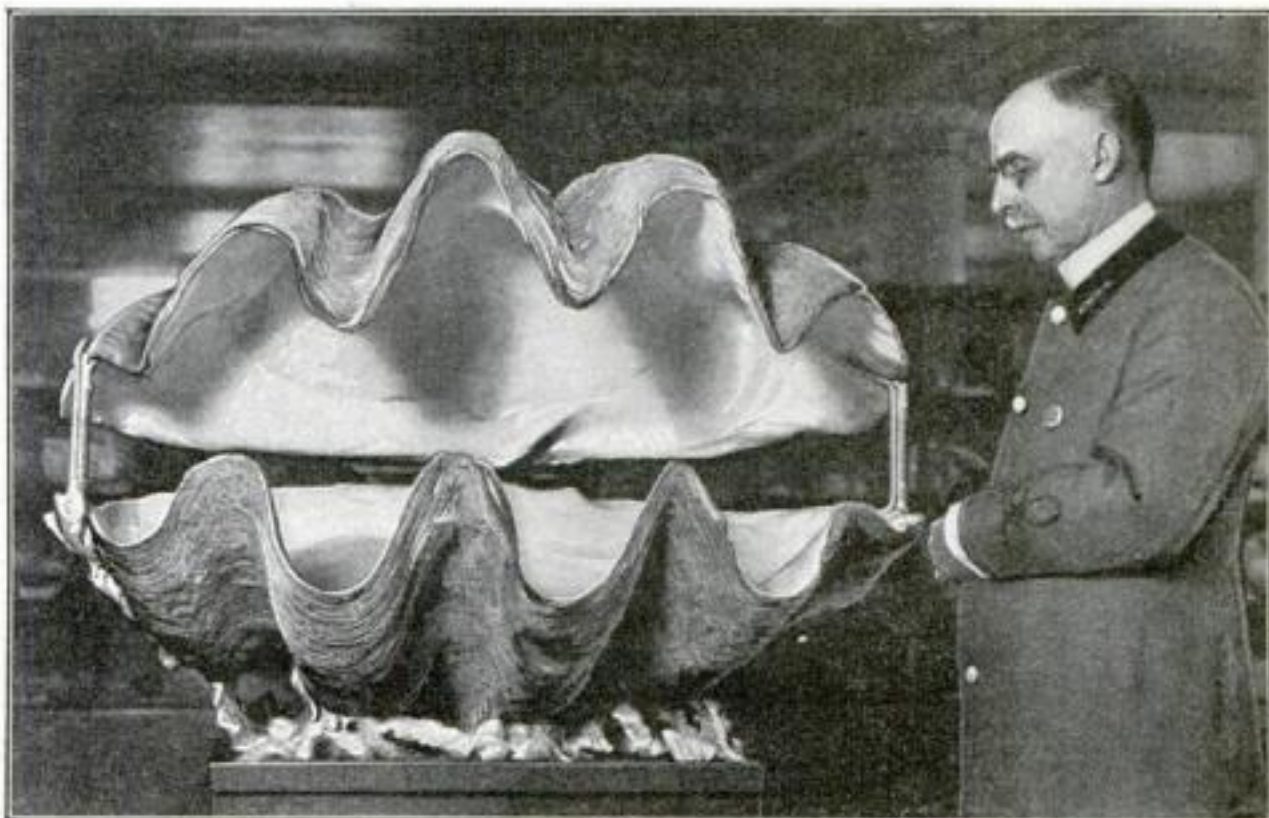
The "honey guide" has a sweet tooth, as well as a liking for the larvae of bees. But he is a small bird, and beehives are hard for him to crack. So he seeks out a man, and when he finds one, perches in a near-by tree and begins to chatter. This means that he knows where there is a first-rate hive, and that he wants the man to follow him. In the same way he leads his human assistant to the hive, stopping at intervals to wait for his slower partner to catch up.

These birds are highly valued in Africa and to kill them is a misdemeanor punishable by law.

New Comet in Western Sky

A COMET that never may have been observed before, recently was discovered at the Bonn, Germany, observatory. It is said to be brighter than any comet that has appeared for several years, being visible through strong field glasses. It is sufficiently well developed to show a faint tail.

Apparently the new comet is moving southeast at considerable speed in the western sky shortly after sunset. There is a possibility that it will become visible to the unaided eye.



World's Largest Clam-Shell on Exhibition

THE world's largest clam-shell, weighing 20 pounds without the mollusk itself, recently was placed on exhibition at the Museum of Natural History, New York City.

The giant bivalves, of which the creature that once wore this shell was one, are native to the waters of the Indian

Ocean, the East Indies, and the Philippine Islands. They are edible, and their shells are so hard that the natives frequently make ax heads of them.

Lying open in clear water, these creatures are said to present the appearance of a submarine garden of the most vivid blue, yellow, and violet hues.



Giant Wingless Bird Is Reproduced in Model

ONE of the exhibits that attracted much attention at the recent British Exhibition at Wembley was a reconstruction of the giant wingless moa bird, which once inhabited New Zealand, but now is extinct.

This great creature, which sometimes reached a height of about 12 feet, was unable to fly. It is believed to have existed up to about the middle of the eighteenth century, when it was exterminated by natives. Some of the species were not much larger than turkeys. Their heads were small and the necks almost bare of feathers.

This model was reconstructed from remains found by scientists.

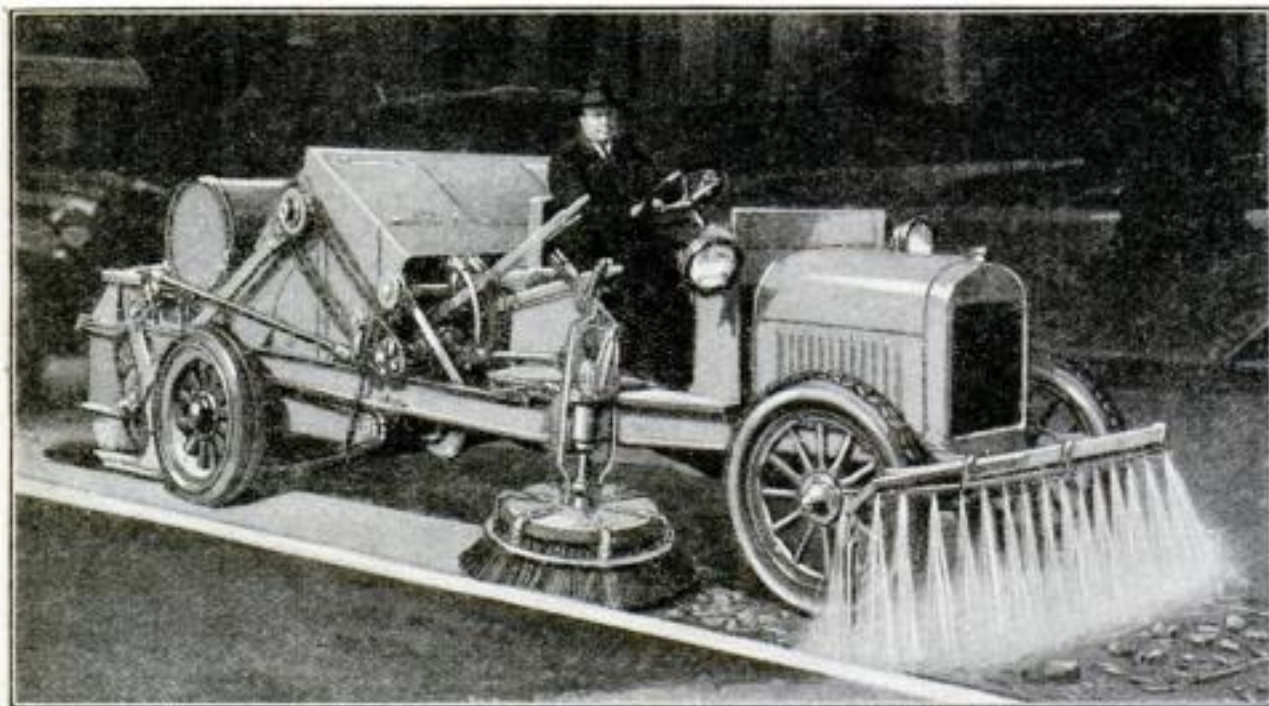
Will Sail around the World in a 68-Foot Boat

"THE longest cruise in the smallest boat" is the slogan of an around-the-world cruise now being undertaken by a party from Chicago, Ill., in a 68-foot all-cypress sailing vessel modeled after a Norwegian ketch. The voyage, which is expected to take two years, is under the direction of Capt. A. J. Duken, an experienced explorer and navigator. It was undertaken to obtain moving pictures and historical data of little known islands of the South Seas.

The ship, known as the *Big Bill*, after William Hale Thompson, former mayor of Chicago, is the first to sail from Chicago to the Orient by way of the Illinois-Michigan Canal, the Illinois and Mississippi rivers. It is equipped with an auxiliary engine, radio, and many other modern improvements.



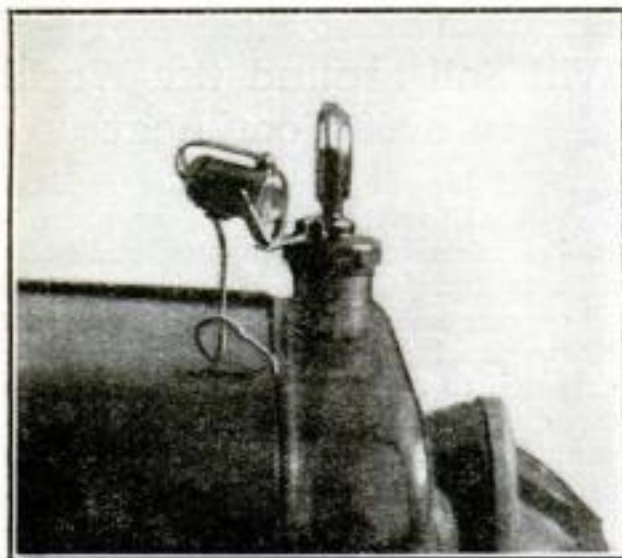
Big Bill ready for two-year world cruise



One-Man Machine Sweeps and Washes Streets

STREET-CLEANING has now come under the eye of science. Herewith is shown a complete street-sweeping and -washing unit that may be operated by one man, the driver of the truck. This mechanical cleaner consists of a street-sweeper, gutter broom, and sprinkling device. It will wash and sweep the street and gutter at one operation, picking up the dirt as it travels.

The gutter broom, made of sectional steel wire, automatically follows the curb line, working in and out with any variations that occur, throwing the refuse from the gutter into the path of the main broom located across the truck at the rear. This deposits the sweepings in the large dust-hopper above. Both brushes are quickly raised when the truck is going to and from its work.



Motor-Meter Light Makes Handy Trouble Lamp

A MOTOR-METER illuminating device (shown at the left) that may be used also for lighting up the motor under the hood when searching for the reason of engine trouble, is easily attached at the base of the motor meter. It consists of a miniature electric lamp wired to the battery of the car.

The bracket allows the lamp to be swung backward for roadside investigation of the motor in the darkness. It is the invention of Philip W. Pulig, of Philadelphia.

Know Your Car

THE proper care and adjustment of the hand brake, which some day may be the only means of preventing a serious accident, is a very important item in the upkeep of a car, yet how many auto owners pay attention to it?

There are several points that may need adjustment or correction. Slipping may be caused by oil or grease working out of the axle, by poor adjustment, or by worn linings. These faults may be corrected by putting a new washer on the inside of the hub, by washing the grease away with gasoline or kerosene, by readjustment, or by installing a new lining.

If the car tends to skid when the hand brake is applied, one wheel is braking more than the other, or one may not be braking at all. The brakes should then be equalized. If the brake is dry and dirty, it will squeak. It should be cleaned with gasoline and a stiff brush. Sometimes squeaks are caused by improper clearance of lining and drum.

Odd Streamlined Car Designed for Speed

ONE of the queerest of automotive creations, the body of which resembles the fuselage of an airplane, recently appeared in London. The engine, mounted over the rear axle, is only 16 horsepower; but the makers claim the car can attain a speed of 85 miles an hour. A low center of gravity and light body construction make this possible, they assert.

Cool air for the motor is drawn in through a tube at the side, while the part of the body that houses the engine is fluted for additional ventilation.

The rear of the

Trigger Catch Eliminates Rattle of Auto Hood

TO COMPLETELY stop the annoyance of hood rattling, a hood catch has been designed with a trigger handle that extends through the side of the hood and engages a loop connecting two springs that are fastened to the frame of the car inside the hood.

The pressure from the springs pulls the hood downward and toward the inside,

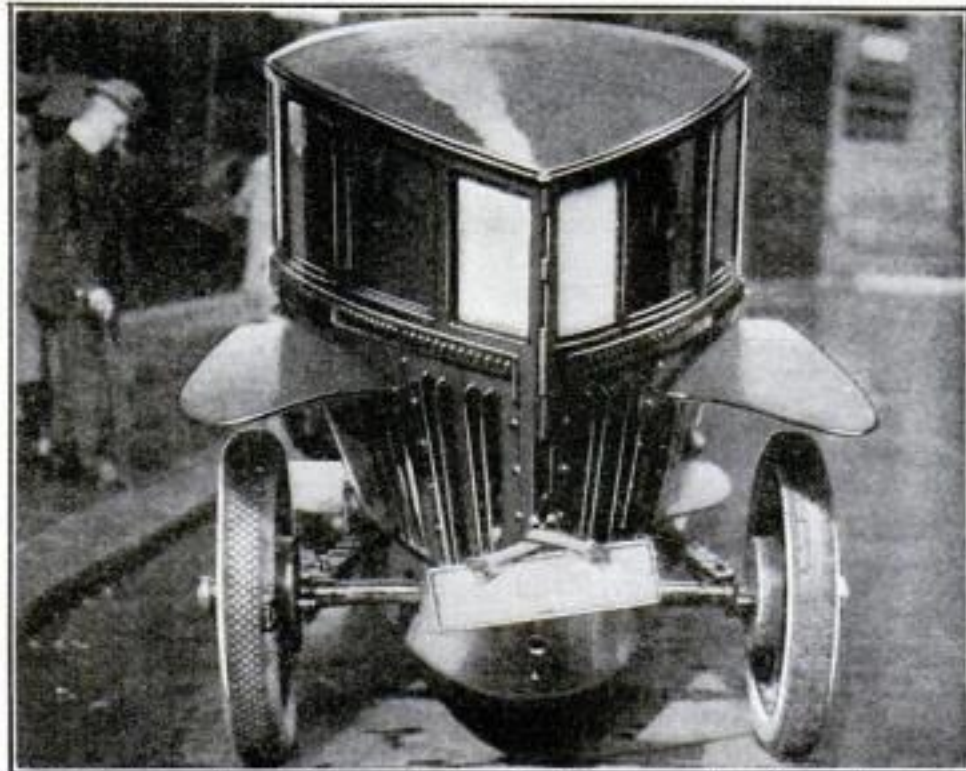
This simple device will prevent the auto hood from rattling. It is easily adjusted or released.



thus holding it firm and snug. The handle is furnished in several finishes.

The device is said to be fastened in place by a light pressure of the hand, and released as easily.

THE streets are not the only places in New York City where there is a speed limit. Elevator traffic in the skyscrapers are subject to traffic laws as well. The vertical speed limit is 600 feet a minute. In other words, an express elevator is permitted to travel at the rate of a mile in about seven minutes. If it exceeds this speed, an automatic "traffic cop," attached to the running apparatus of the elevator, jerks it to a stop.

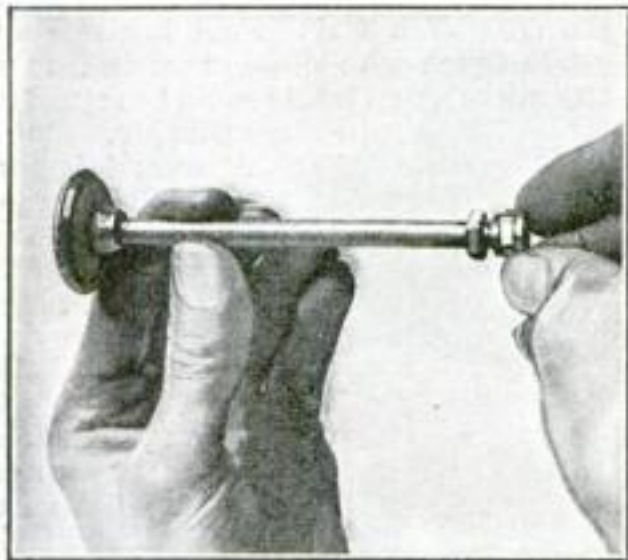


This car, shaped like an airplane fuselage, goes 85 miles an hour

Valve-Stem Adjusters to Increase Car Power

TO DECREASE the noise and increase the power of Ford motors, adjusters may be added to the valve-stems. These consist of a pair of adjustable nuts that may be adjusted by the aid of two wrenches.

In worn automobile valves the attachments are said to give full lift to the valves. Their attachment is claimed to be very simple.



Adjusting nuts on a valve stem

Prove "Lean" Spark to Be as Good as a "Fat" One

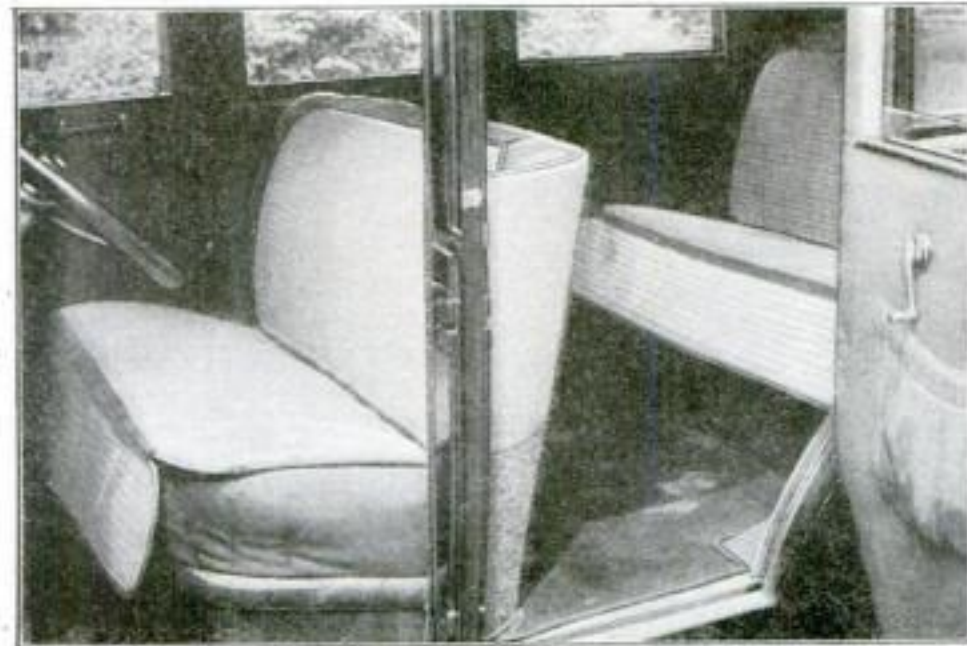
EXPERTS of the U. S. Bureau of Standards have just disproved another cherished belief of motorists. They have found by exhaustive experiments that a "fat" spark gives no better ignition and no more power than a "lean" one.

Their suspicions of the correctness of the accepted doctrine were aroused by experiments in Germany, where engines tested with various kinds of sparks failed to show any differences in power developed.

They found that the spark from the feeblest flivver coil was on a par in effectiveness with a spark from the most expensive magneto.

Covers to Keep Auto Upholstery Clean

BELOW is pictured a new seat cover that is said to be serviceable, easily adjusted, and neat looking, and that any one can install. It is made of rice straw specially treated to render it durable.



Straw cushion covers bound with cloth for the closed car



Small Car Falls 60 Feet into River and Runs

A REMARKABLE wreck picture was obtained recently when a photographer, taking pictures of scenery near Philadelphia, saw an automobile skid 60 feet over a rock embankment and land in the creek below. The photographer snapped the camera before the driver of the car was able to bring it to a standstill.

The driver is seen making a futile attempt to control the car and steer it out of deep water. He was uninjured, and a

broken radiator was the chief damage suffered by the car.

A SOILS laboratory on wheels, with the necessary professors, recently completed an educational tour through several counties in northeastern Ohio. More than 2500 people attended the laboratory classes, many fetching with them samples of sick soil that the professors examined and prescribed for.

THE Editor will be glad to supply, wherever possible, the names and addresses of manufacturers of tools and devices mentioned in this issue of POPULAR SCIENCE MONTHLY.

New Adjustable Hose Clamp

MADE of tempered steel springs of cold-rolled steel the positive hose clamp at right can be quickly attached to water-hose connections without the use of tools.

The clamp, according to its manufacturer, is provided with a pawl-and-ratchet device that makes it instantly adjustable merely by moving the pawl to the proper notch. By pressing the lever back, the clamp is tightened instantly. The clamps are manufactured in several sizes.



How Much Do You Know?

WRITE down the answers to the questions below to the best of your ability; then turn to page 165 and see how nearly you come to a perfect score.

1. Why does a boomerang return?
2. What gland affects our growth?
3. What is steel?
4. Why doesn't stout persons' skin burst?
5. What is the difference between planets and fixed stars?
6. How are the seasons caused?
7. What is a crystal?
8. Why is it possible that the inside of the earth is growing hotter instead of colder?
9. What would happen if an irresistible force met an immovable body?
10. How do plants differ from animals?
11. What rare chemical element is necessary for the growth of teeth?
12. Do electrons really move through a wire when an electric current is flowing?

Radio—the New Paul Revere

Broadcast network to link nation in emergency—Other useful developments and inventions

ONE of the most important steps in the development of radio broadcasting is about to be announced by the Bell System. According to advance information, a vast network of interconnecting telephone lines throughout the country is to be set aside permanently for the purpose of linking broadcast stations for events of national importance.

Up to the present, multiple broadcasting has frequently been arranged. The greatest number of stations hooked up to one studio has been 19, across the northern states. It is understood the new arrangement will cover the entire country. This is in accord with the recommendations of Secretary of Commerce Hoover at the Third National Radio Conference.

The new network will cut out the tremendous amount of preliminary work always necessary before the broadcasting of a national event. This invariably has meant taking telephone wires out of service for several days.

The new system will be invaluable in cases of national emergency, when it is necessary to get important information to all of the people in the shortest possible time.

New Light on Static

CONTRARY to previous belief, radio interference from static electricity is bad in the Far North. This is the statement of the Arctic explorer and scientist, Dr. Donald B. MacMillan, who recently returned from a 15 months' expedition into the polar regions. One of the primary objects of his voyage was to study the effects of static on wireless reception.

Static was especially bad during the terrific magnetic storms that occur in the north. Some of the disturbances were so violent as to move the magnetic needle of his recording apparatus like a scribbling pen across the record sheet.

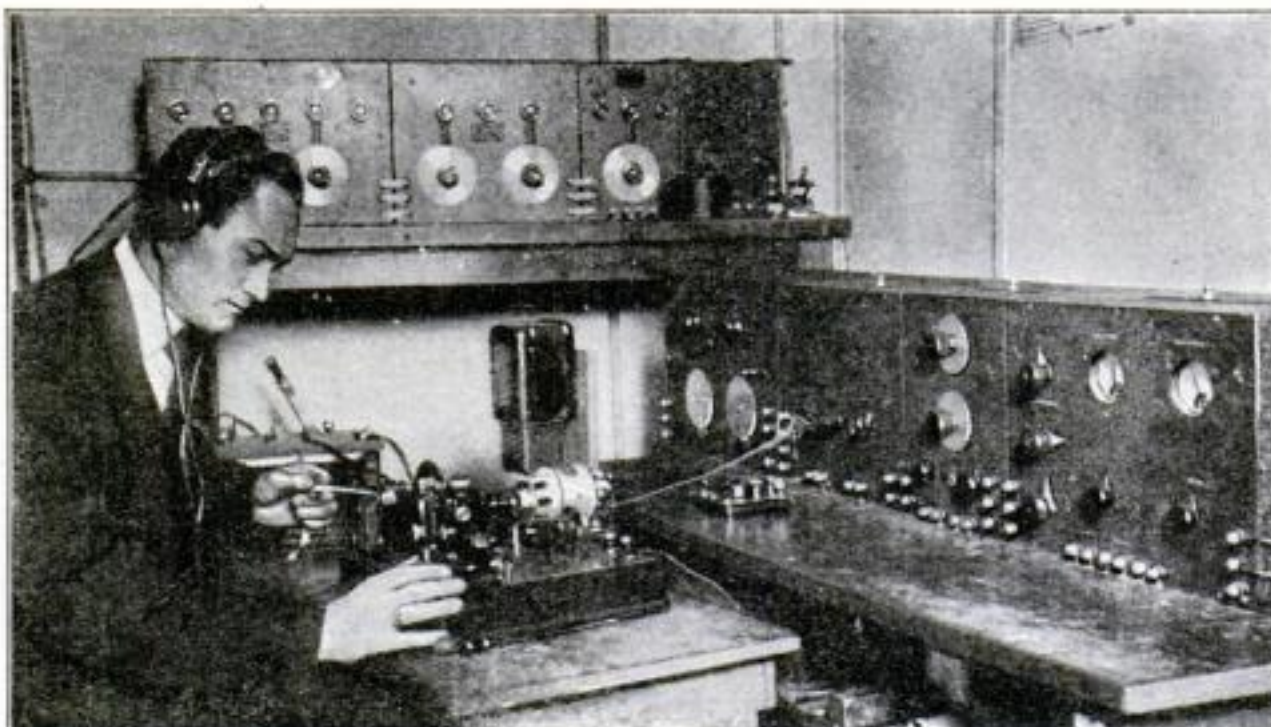
The aurora borealis apparently has no effect on radio transmission, according to Doctor MacMillan. When his ship passed through the aurora belt no unusual effect on the signals was observed.

During the four months when the Far North was in continuous darkness, the explorer heard

By Jack Binns

America's Most Popular Writer on Radio

clearly the messages of hundreds of amateurs, but as soon as the long hours of daylight arrived, short waves faded rapidly. During the four months of daylight he was cut off from the world.



One of the most remarkable of the new radio inventions is this automatic radio recorder, which is said to be able to copy signals accurately even when static is three times as great as

the signal strength. The inventor, Dr. A. Hoyt Taylor of the U. S. Navy Department, claims the machine can copy 100 words a minute and that it will revolutionize radio-telegraphy

Radio for the Railroads

SEVERAL important radio communication tests aboard fast express trains have been made recently by railroad engineers with improved radio equipment. On the whole, these tests have been successful, but much remains to be done before satisfactory commercial results can be obtained. Among the railroads that made the experiments were the Pennsylvania, Chicago, Milwaukee and St. Paul, Northern Pacific, and Lackawanna.

One of the chief purposes of the tests has been to find a successful means of communication to and from moving trains to supplement the present block system. With such a system in operation the crew of a train could immediately get in touch with dispatchers in case of any mishap, and traffic could be regulated accordingly.

A second important object is to connect passengers aboard fast express trains with the regular telephone system, so that a business man in his office could converse with his associate en route between New York and Chicago, for example. Third, but less important from the railroad point of view, is the arrangement of broadcast concert reception for passengers.

The immediate problem is the development of an efficient transmitter for trains. This must be a radio-telephone apparatus of high

efficiency because of the difficulty of getting a good aerial on the train. There already exists a system of two-way conversation. Successful transmission over an appreciable distance from a moving train, however, has yet to be developed.

Talk over Power Lines

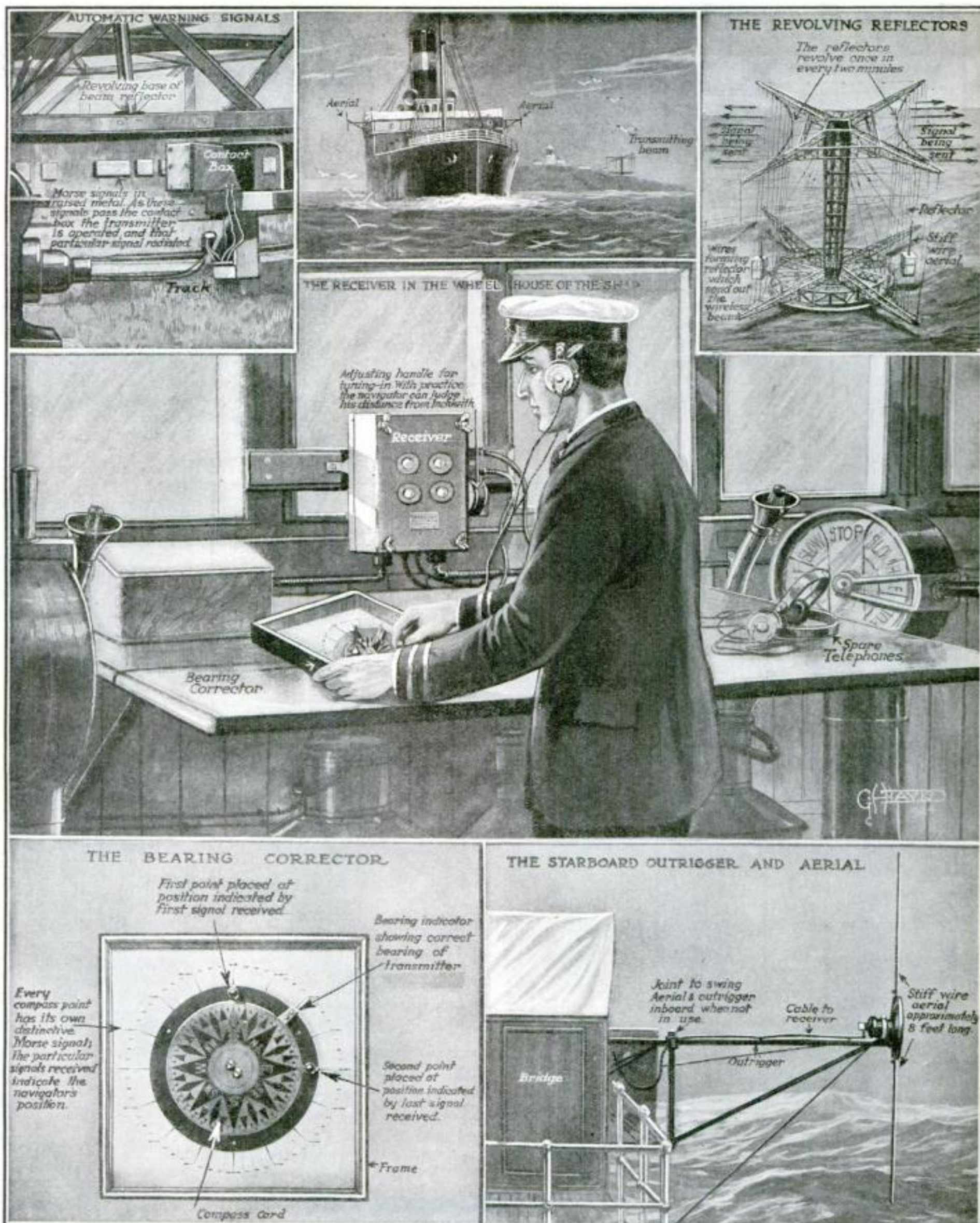
THE system of "wired wireless" which at one time threatened the supremacy of radio, is rapidly finding its utility in communication work for light and power companies. Recent laboratory work followed by practical application on the lines of a power company in Indiana have resulted in important gains in efficiency.

Under the new arrangement a metallic circuit is used exclusively in place of the ground connection. Communication is accomplished by placing a carrier of radio frequency on the power line, and modulating it in exactly the same manner as in the usual broadcasting system. The amount of power necessary is comparatively small, for the wave is confined to the line that carries electric power for industrial purposes.

The metallic circuit is obtained by using one wire outward, and a different wire for return. An increased efficiency of 500 per cent is claimed. In cases of emergency, communication can be maintained.



Although extremely small, this new loop aerial is said to be very efficient, due to unusual construction and winding, designed to reduce distributed capacity, and prevent losses



The "Radio Lighthouse"—An Amazing New Use for Marconi Beams

AN IMPORTANT new commercial application of Marconi's reflected beam system of short-wave communication is the use of the beams for a "radio lighthouse." This new system, perfected by Marconi and C. S. Franklin, his assistant, is explained in the above drawings made by G. H. Davis from sketches during the first successful experiments in guiding the steamship *Royal Scot* past the rocky island of Inchkeith in the Firth of Forth. The reflector that sends out the radio beam consists of a series of vertical wires arranged in

parabolic curves. It is rotated around the radio transmitter, just as the reflector of a lighthouse is revolved around the lantern. At the base of the reflector are a number of Morse signals in raised metal, each signal corresponding to a given direction on the compass. As these dots and dashes pass a contact box, the transmitter operates and radiates the corresponding signal.

In the ship is a compass card, with pointers attached, called the "bearing corrector." Around this card are Morse signals corresponding to those

on the base of the projector. Thus, when the ship's navigator hears a certain signal, he sets one pointer to the point of the compass indicated. Then, when he hears it again, he adjusts a second pointer in a similar way. An indicator spaced midway between these points then gives him the correct bearing of the "lighthouse." By a tuning device he also can tell how far he is from the "lighthouse."

The signals are picked up by stiff wire aeri-als attached to outriggers on each side of the ship.

Confessions of a Radio Gyp

As Made to Newton Burke

How the cheaters "bootleg" tubes, fake condensers, and coils—An inside story filled with hints to protect your purchases

MAYBE you've noticed that there aren't as many radio stores as there used to be. Do you know why? It isn't that public interest in radio is dying. Far from it! The number of fans is increasing every day. But the gyps—the cheaters who jumped into radio on a "fly-by-night" basis when broadcasting began and reaped a golden harvest for a couple of years selling bad parts and sets for good money—they've begun to quit. They are closing up shop.

No, the game isn't played out altogether. There is still plenty of it going on. But it is getting harder every day. The public is getting radio-wise, and besides, the high-class musical-instrument stores and electrical shops have come into the industry with real business methods and are taking the trade away from the gyps fast.

These big stores have all kinds of facilities for pleasing the public. For example, they have credit backing that enables them to sell the best receiving sets on time. That's why the gyps are dropping out. I closed my store three months ago.

I MUST say, though, that while I was at it, radio was the softest thing I ever tried. When the craze first hit the country, the fans would flock to our stores in droves. They read everything that was printed about radio, and the newspapers had new circuits for them to try almost every day. They'd come to us looking for the parts specified in the newspaper articles, and we always had them on hand, because we had cheap help making them in a back room—imitations in junk of the parts made by national manufacturers. Coils wound on cardboard tubes, for example, that cost us perhaps 50 cents to make, and sold for six dollars each. Those were the good old days.

I remember when there was a run on variocouplers of the 180-degree type. These were made by a young man who had just started in business for himself. They were wound on bakelite tubes with double silk-covered wire. The two bakelite tubes were held together with an

aluminum frame that permitted the inside coil to be rotated through 180 degrees.

It was a fine coupler, there was a great demand for it, so we copied it. Only, instead of bakelite, we used cardboard painted black, and we took a mold of the aluminum frame and cast it in lead. Thus we were able to "reproduce" the coupler for a few cents.

The original coupler had a list price of \$6.50. We printed the same price on ours. Then we advertised them exten-

sively at cut rates, and sold thousands of them at four dollars each. The man who designed the coupler soon went out of business. The big car I'm driving today was bought on the profits I made on that deal.

litigation to be completed; besides, you can generally find some interference claim against any patent; so it's pretty easy to infringe for awhile.

Take the regenerative circuits, for example. When radio sets began to sell widely, almost all licensed manufacturers were getting what today would be considered large prices for one-tube regenerative sets, and they couldn't supply half the demand. This furnished a situation that we found made to order for us. We collected the cheapest parts we could find and hooked them up regenerative style. We always could find some young amateur who would supervise the job and see that it was done correctly. Cut-rate advertising did the rest.

OUR "beautiful mahogany cabinets" were stained pine. Our "genuine bakelite" or "hard rubber" panels were "mud"—cheap powder molded in a form. And the fans who bought these sets thought we were public benefactors because of our prices!

Condensers didn't even cause us the trouble of making them. They were shipped to us by gyp manufacturers, all ready to sell; for, of course, there were almost as many gyp manufacturers as storekeepers. They would copy all the popular models of condensers, using tin plate instead of aluminum or brass, and fiber insulation.

Tubes undoubtedly were our best line. In

fact, they were the first thing to be "bootlegged" in radio. The tube bootlegger, who, of course, was a man who was manufacturing tubes without a license, would move his plant overnight if the licensed manufacturers happened to locate it, and open up in a new place the next morning. Then some of the big independent manufacturers discovered there was some uncertainty in the law covering the tube patent. After that it wasn't necessary for the gyps to move so often, and they turned out tubes faster than ever.

Tubes were bound to be a profitable line for the gyps, because the licensed manufacturers couldn't come within miles of supplying the early demand. At first

(Continued on page 172)

Beware the Trickster!

His "solid mahogany" is stained pine.

His "genuine bakelite" and "hard rubber" panels are cheap composition.

His cut-rate tubes are "rebuilt."

His "aluminum" condenser plates are tin.

His tuning coils are wound on cardboard.

He sells you "standard" sets and parts that never saw the factory of the manufacturer whose name and trademark they bear.

Here's the inside story of the Radio Gyp and his methods—an exposure of his tricks; vital information that may prevent you from being swindled.

It is an article that brings home to us the value of dealing with concerns with established reputations for honesty and fairness.

As you read this story, remember that you have at your service the Popular Science Institute of Standards. A list of products, tested and approved by its engineers, will be sent you on request.—THE EDITOR.

ONE of our best tricks was to make up some piece of junky apparatus, give it an impressive name, put it in a good box with a pretty wrapper, and then label it "patent pending," or "patent applied for." We'd invariably sell thousands of such articles, whether they had any place in a radio set or not.

And of course the fact that an article was patented never bothered us. It always takes time, you know, for patent

How I Play Radio Doctor

Simple Remedies that Will Keep Your Set out of Trouble

By M. B. Sleeper

IF YOU own a radio set, the chances are that you have some "expert" friend who very willingly offers to help you out when anything goes wrong. He tells you he has built several radio sets himself and knows all about them.

And the chances are that if you have invited him to dig into your set, you have found that instead of improving it, he has left it worse off than before. Likewise, you have discovered, perhaps, that whenever you yourself try to tinker with your set to make it perform better, you succeed only in causing yourself all kinds of trouble.

If you had a sore ankle that impeded your walking, you wouldn't let some friend perform a major operation on your vital organs, would you? Why, then, should you operate on the vital mechanism inside the cabinet of your radio set when the trouble may be nothing more than a broken antenna wire or a bad ground connection?

Yet the fact remains that radio-set owners by the thousands persist in doing the most absurd things in trying to shoot trouble where there is nothing wrong at all.

THE old adage that "a little knowledge is a dangerous thing" never was more truthfully applied than it is to radio. I have found in my own case, though,



EXAMINE CONTACT HERE

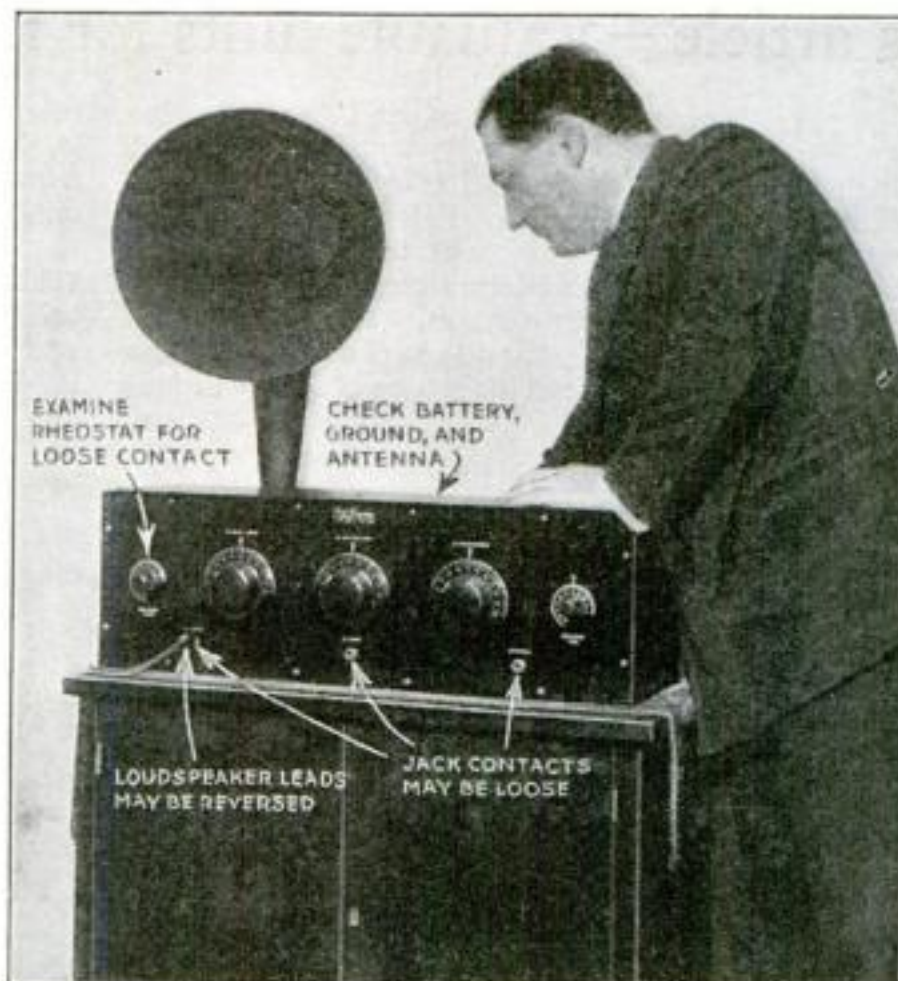


AND HERE

working right, are as simple as bandaging a cut finger. And because they are remedies that the owner of any radio set can apply, I am describing them in this article.

The first thing to remember, then, when your set isn't performing just right, is that radio outfits built by reputable concerns are so thoroughly inspected that there is very little likelihood anything will go wrong inside if they are given reasonably good care. In 99 cases out of a hundred, the trouble lies outside the set itself—in the tubes, the batteries, telephones, loudspeaker, antenna or ground.

Whatever the symptoms of trouble are,



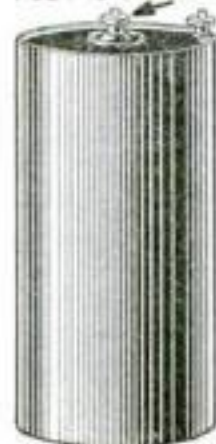
"When your set fails to work right," says Mr. Sleeper, widely known radio engineer, "the chances are 99 out of 100 that the trouble lies outside the set itself, and can be remedied without prying within the cabinet." Common sources of trouble are shown in the photograph above and in the small sketches on this page

the best thing to do is to test these points in the order in which I shall give them.

Before anything else, look at your antenna. Make sure it is up. See that the lead-in is not broken. Look for a metal object that might have fallen on it. Examine the antenna binding post on the set for perfect connection.

Go over the ground lead in the same way. Frequently it is kicked off and broken. Perhaps the connection with the water pipe has become corroded. I know of one case where, in changing the plumbing, a pipe was disconnected from the water system so that it served as a ground no longer. If the antenna lead or ground wire is insulated, the wire may have broken inside the insulation.

REMEMBER THAT CENTER POST IS POSITIVE



LUGS OR WIRES MAY BE CORRODED



the tubes have burned out. If the tubes burn dimly, the A battery probably is low. Remove all but one tube from the set and see, when the one remaining tube is lighted, if it burns below its normal brilliancy. If so, new dry cells are required or the storage battery must be recharged.

DO NOT test either dry cells or the storage battery by short circuiting, to see if there is enough energy to make a good spark. That test tells nothing and runs down the batteries. Every radio-set owner should have a good voltmeter. It must be of 10,000 ohms resistance. Such a meter costs about eight dollars. If you cannot spend that much money, do not get one at all, for the pocket type is worthless in testing radio batteries. Get a voltmeter to read up to 50 volts. This will serve both for the A and B batteries.

Four dry cells connected in series should read not less than five volts, or the same value for a storage battery. The best test on a storage battery, however, is made with a hydrometer. Full directions for its use come with it. It will tell you the exact state of the battery, whether it is fully charged, half charged, or entirely discharged. A hydrometer costs about a dollar and a half. If you are going to have guests and want to make sure that there is enough energy in the battery to last through the evening's entertainment, test the battery the day before. Then you will have time enough to charge it if it is dangerously low.



SEE IF SPRINGS HAVE BEEN BENT DOWN

THE first test for the B batteries is to put the set in operating condition, with the tubes lighted. Then disconnect

BE SURE THAT SPRINGS MAKE CONTACT



the negative terminal of the B battery. This should give a strong click in the phones or loudspeaker. If it does not, the B batteries have run down, the jack is not making perfect connections with the telephone plug, there is a loose connection in the plug, a broken lead in the telephone cord or the telephones themselves are defective.

These latter points also apply to loudspeakers. Test the batteries with your high resistance voltmeter. Each 22-volt unit should read at least 17 volts, or each 45-volt unit at least 34 volts. If the

(Continued on page 171)

A-B-C's of Radio Language

If the names of parts in your set puzzle you, you should read this article—Valuable hints for the novice

By Robert E. Martin

ONE of the most difficult things to understand about radio is radio language. Many a broadcast fan, I am sure, has been frightened away from learning something more about his receiver than how to set the dials because, when he sought information, he found himself lost in a maze of technical terms.

Yet the language of radio is no more difficult than the language of baseball, or the language of finance, once you have the key. You would scarcely expect a baseball writer to explain in detail just what a "base on balls" was every time he had occasion to use the term.

Similarly, the radio writer or the radio engineer in describing a hook-up would find it most inconvenient to say, "you insert here a resistance device connected from the grid of the vacuum tube to the filament to prevent the likelihood of the tube's failing to function properly through too high voltages collecting on the grid." So he says instead, a "grid leak," which, when you understand its purpose, you admit is an apt and graphic term.

IN OTHER words, the terms of radio, which may seem like a foreign language to you, really are used for convenience—yours as well as that of the radio engineer.

These are the real a-b-c's of radio, and to understand radio without knowing what they mean is quite as impossible as it would be to understand an automobile without knowing the difference between a spark plug and a carburetor.

There are two ways that occur to me of learning the terminology of radio. The first is the obvious way. Get a good radio textbook, go off to a quiet room, and study. That method, however, probably wouldn't be particularly enjoyable. The second method consists of thinking in radio terms as you operate your receiving set. That you can do without in any way interfering with your enjoyment of the

broadcasting. Let us see how you can go about it.

A few days ago, in the radio laboratory of the Popular Science Institute of Standards, I saw a three-tube set, having a detector and two stages of audio-frequency amplification. If you read my last article, you will recall that this means a set that not only can pick up broad-

many Inductance," "Coupler," and three knobs are lettered merely "Fil." Your friend has explained to you how pulling out a little nicked button connects the batteries with your set. He has told you that you place your telephone plug in the orifices marked "Detector," "First Stage," and "Second Stage," depending on how loud you wish the signals to be. He has

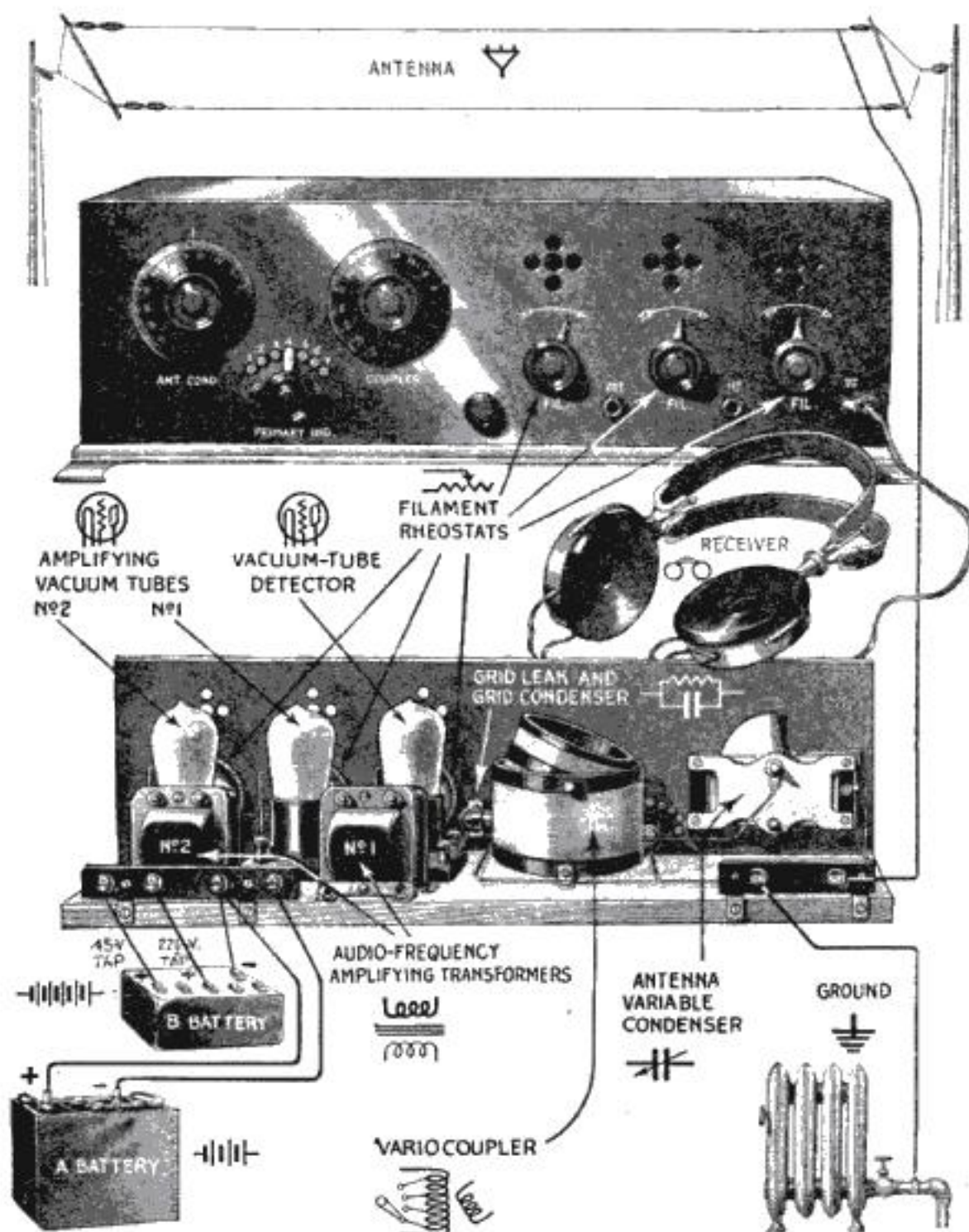
told you that the three little knobs lettered "Fil." are not to be turned beyond a certain point unless you want to buy a new tube to replace one that has been burnt out. Then he has told you that by turning the two dials and the other knob you could tune in broadcasting—probably demonstrating how it was done—and left you to your own resources.

PROBABLY for the first couple of evenings thereafter you are content merely to turn the knobs in a more or less mechanical way, satisfied so long as you hear the broadcasting. Then you become curious; you open the cover of your set and peer in. Outside of the three vacuum tubes, whose use and purpose you probably understand already, the most striking piece of apparatus you see—because it is the largest—is the double coil operated by the dial marked "Coupler." This device is what is called a *vario-coupler*. Its purpose is to help you tune your radio set by varying its *inductance* so that only radio waves of a desired frequency of vibration will be admitted.

Inductance means the property that causes a coil of wire

through which an electric current is flowing to become a magnet. Whenever you have a coil of wire connected in a radio set, you have an inductance. If a second coil of wire be placed near the first, the magnetism of the first coil will transfer electrical energy to the second coil by *induction*, the coils being called respectively the *primary coil* and the *secondary coil*.

The two coils need not be in contact;
(Continued on page 174)



Front and rear views of one of the simplest forms of radio receiver, with each part accompanied by its name and symbol. If you study the purpose of each part in

your set as explained by Mr. Martin, you will see how aptly each name is applied, and it will soon lose its terror. These names are the real a-b-c's of radio science

casting, but can magnify received signals so that you can hear them better.

Now, imagine you have bought this set, and, with the assistance of some friend who has had experience in radio, have installed it in your home. A and B batteries are connected properly, your aerial is up, and your ground connection has been made.

On the front of the set—the "panel"—are two dials and four little knobs. These are lettered "Antenna Condenser," "Pri-

Who Can Build the Smallest Set?

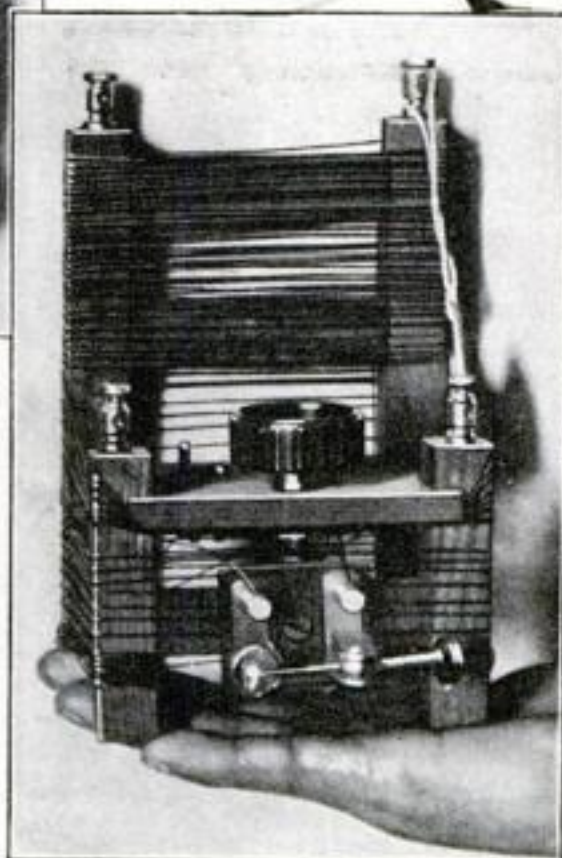
Amazing Midget Receivers and Parts Displayed at Radio Fairs

Recent radio fairs have brought to light what are probably the smallest receiving sets and parts in the world. Below is a midget head phone, about the size of a finger-nail, that was made by E. Dickey of Dayton, Ohio

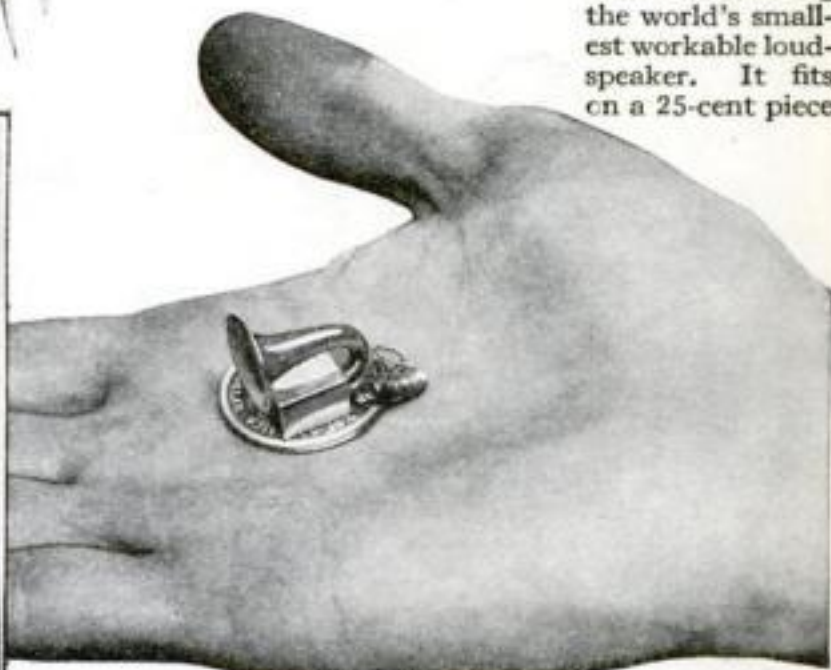
Did you ever try to see how small you could make a receiver? Herman Burgess of Washington, D. C., made the finger-ring crystal set shown below. It is only a quarter of an inch long and wide, yet Burgess declares that it will bring in local stations clearly



Building receiving sets into miniature pieces of furniture has become a fascinating new pastime. The tiny crystal set built into a piano, shown above, is the work of C. W. G. Brown of Chicago, Ill. It has a close rival for smallness in the ingenious "electric chair" set (at the right) built by Leonard Aswald of the same city. In each case you can get an idea of the size of the midget by comparing it with the hand that is supporting it



Ivan Nedland, of Hillsboro, N. Dak., claims the distinction of building the world's smallest workable loudspeaker. It fits on a 25-cent piece



Below are six of the smallest sets and parts, placed on a ruler to show their size. From left to right they are: Crystal set built by Henry Dahl of Minneapolis; another by Edith Boreman of Bethany, Neb.; a tiny dry cell built by Patsy Cordi of Derry, Pa.; a crystal set made by Dr. Hugo Thompson, of Springfield Mass.; a complete midget loudspeaker unit built by J. W. Fuller, Jersey City, N. J., and a crystal set built by T. L. Cranston, Toronto, Canada. All of them actually work



How I Get the Most out of Two Tubes

An Unusually Compact Loudspeaker Set You Can Build Cheaply

By H. G. Silbersdorff

EVERY so often a new circuit appears. A few odd-looking connections shown in the diagram bite into the curiosity bump that we all have, and before we know it we are lying awake nights wondering how this part can be

pleasing results are those that lean toward standard practices in radio-circuit designing. Many tricks have been resorted to to eliminate losses, and when a standard circuit is incorporated into a set in which care has been taken to avoid these losses of electrical energy, the results usually are surprising.

The circuit I am presenting here is that of a two-tube receiver which, according to tests, will give about all that can be expected of two tubes. It is a combination of radio frequency, regeneration, and reflex. It is comparatively simple to construct, takes up little room, is economical in operation, easy to operate, and will afford loudspeaker volume. A large number of the distant stations can be heard with a good degree of consistency.

An added attraction is the fact that the set can be made up compactly, requiring but a seven-by-12-inch panel and cabinet. This puts it into the semi-portable class, so that it can be placed in the tool compartment in the rear of your car, should you want it there.

wind the spider-web forms. These can be obtained in any radio-supply store; in fact, even the 5 and 10 cent stores offer complete forms, together with the adjusting arm and knob.

The first form contains both the primary winding, which is untuned and consists of 10 turns of wire, and the secondary, which consists of 45 turns of No. 22 wire. The winding of this form is so arranged that the 10-turn primary is located in the center of the secondary winding. That is, start winding the secondary coil, and after making 22 turns, do not cut the wire, but leave the end loose and start winding the primary. When 10 complete turns have been made, leave a lead of about six inches and then continue winding the remaining 23 turns of the secondary. Be sure both windings go in the same direction and wind the wire tightly, otherwise trouble will be experienced in getting the proper number of turns on the form.

THE tickler coil, which is wound next, consists of about 20 turns of the same size wire. I say about 20 turns because this will vary in some cases. In operation, if trouble is experienced in getting the set to oscillate on the lower waves, it will be necessary to add a few more turns. Using an aerial consisting of a single wire 110 feet long, the set seems to break into easy oscillation on all wave lengths when about 18 turns are used. It is something for the individual to experiment with.

The diagram is self explanatory. The



H. G. Silbersdorff, noted New York expert on reflex receivers, with the new loudspeaker set which, he says, has proved it will give the utmost that can be expected from two tubes without sacrificing quality

made, or how that point can be arranged to get the shortest leads to the tube.

After spending much time and money in experimenting with the so-called new circuit, we come to the conclusion that there really is nothing new about it, and charge the whole item off to experience.

ONE tube has the ability of giving us just so much selectivity, volume, and distance. Two will give us just so much more of either volume or distance, and the same applies when three are used. Regardless of the circuit, if losses have been considered in the construction of the set, we can hope to get only as much out of one or two tubes as is in those tubes. In other words, we can get only as much out of the tubes as the circuit will permit us to take.

Some circuits are admittedly better than others, and it is noteworthy that the circuits from which we obtain the most

The parts required are:

- 1 7 by 12 panel
- 1 7 by 12 cabinet
- 2 spider-web forms
- 1 spider-web form bracket
- 2 tube sockets
- 1 rheostat
- 1 audio-frequency transformer, 10 to 1
- 1 iron core, radio-frequency transformer
- 1 .0005-mfd. variable condenser
- 1 .00025-mfd. condenser with grid-leak clips
- 1 .001-mfd. mica fixed condenser
- 2 .00025-mfd. mica fixed condenser
- 1 open-circuit telephone jack
- 1 grid-leak mounting
- 6 binding posts
- ½ lb. No. 22 d.c.c. magnet wire

An assortment of wood screws, bus bar, spaghetti, and soldering iron, also will be necessary.

In building the set, the first task is to



Front view of the panel, showing the remarkable simplicity of operation. Besides the variable condenser dial, the only tuning control is the knob at the lower left, which operates the coil controlling regeneration

- 1 closed-circuit telephone jack
- 1½-megohm grid leak
- 1 piece hard rubber, 1¼ by 8 by ¼ inches
- 1 baseboard, 11 by 8 inches

one point that varies from the usual practice is the insertion of the tickler coil in the plate of the radio-frequency tube, which gives radio-frequency regeneration. Tests showed that the set had less tendency to squeal and howl when it was inserted at this point, rather than in the plate circuit of the detector tube.

The circuit will howl when the tickler

coil is advanced too far. Preventing this is simply a matter of becoming familiar with the operation of the circuit and noting the best points of advancement for the coil on given wave lengths. As in other types of regenerative circuits, when a station is first tuned in, a whistle will be heard as the tuning condenser dial is adjusted. The next operation is to reduce the regenerative action by separating the secondary and tickler coils. When once a station is logged, it always can be obtained at a later time on the same setting.

Occasionally, in a set of this type, even with the addition of extra turns on the tickler coil, difficulty is experienced in getting the set to oscillate on the lower wave lengths. If this should be the case, the insertion of a grid leak with a value of .075 across the primary of the audio transformer will bring the desired results.

As a matter of fact, a leak at this point always is an advantage, for it enables the set to break into easy oscillation over the entire wave-length scale—a thing that is necessary to obtain long-distance reception.

A word about the transformers. Select a radio-frequency transformer made by a nationally known manufacturer. A curve usually can be obtained on a good transformer, and this, it should be noted, must cover the broadcasting range. For reflex circuits such as this a transformer having

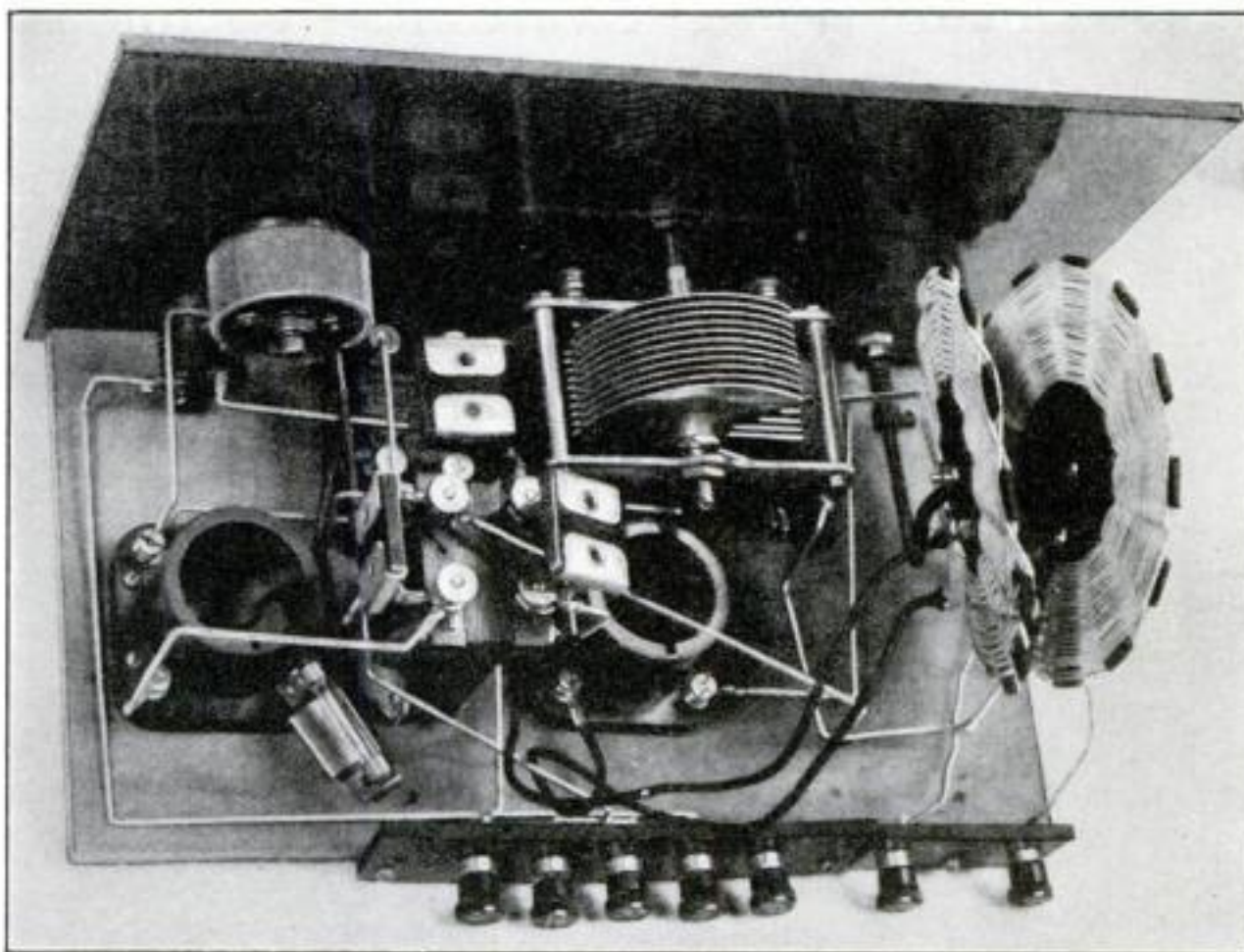
The set will operate with any of the standard tubes, although greater volume can be obtained with the UV-201A type. If you use these tubes, which have their filaments connected in parallel, a

in a corked bottle overnight makes the ideal soldering liquid. After a joint is once made with this mixture, the alcohol dries quickly from the heat, leaving a clean joint that will cause no troublesome noises in the set after it has been in use a year or more.

For the most satisfactory results it will be well to follow closely the wiring diagram shown on this page. The rear-view photograph, showing arrangement of parts and wiring, will serve as a guide to aid you in making the connections.

The importance of tight connections cannot be over-emphasized; for on them depend the real quality of reception.

With a good aerial and ground, I have found that this set gives me everything in the air that I want to hear.



Rear view of the two-tube set, showing the compact arrangement and wiring of the parts

20-ohm rheostat must be supplied.

The current drawn from the two tubes is only half an ampere, and under this load a reasonable amount of service can be obtained with the use of four dry cells connected in series. Needless to say, because of the steadier current obtained, the ideal thing is the storage battery, which can be of six volts and for service with two tubes about 60 ampere hours.

Using the WD-11 or WD-12 types of tubes, three or four dry batteries connected in parallel and a six-ohm rheostat give good results. Usually these tubes will not permit the use of a higher plate voltage than 45, consequently the volume

will not be as great as in the case of tubes for which the voltage can be raised to 90 volts, giving ample volume for the average household on a loudspeaker.

A little care in wiring the set will pay. After wiring many sets of various type, I have found that the very best kind of soldering flux to use can best be made at home at slight cost.

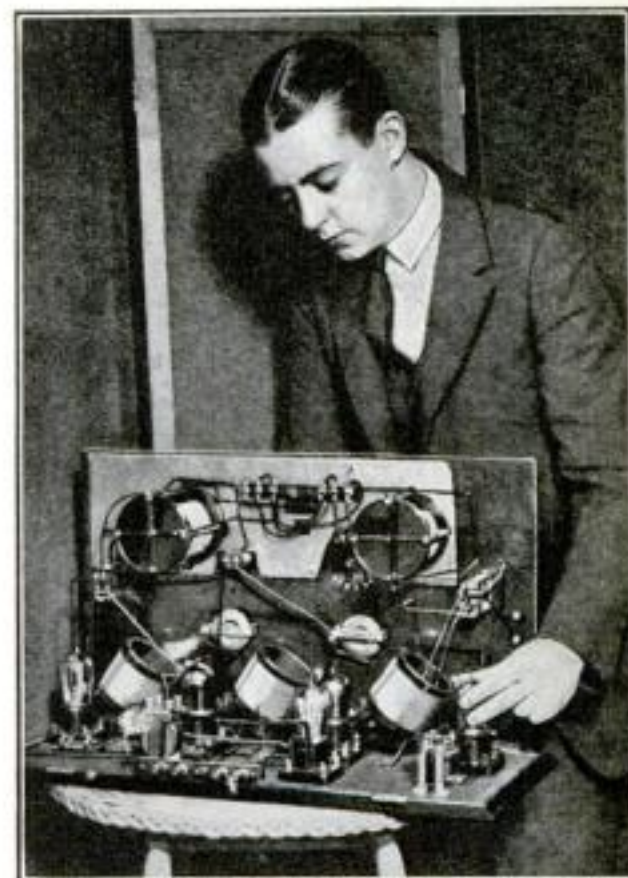
It consists of a mixture of one part of powdered rosin to 10 parts of alcohol. Pure rosin can be obtained in any musical supply store in the block form. A fair sized piece is placed in a piece of cloth forming a bag and crushed to fine powder by pounding it with a hammer on a cement floor. Powdered rosin also can be obtained, but it usually contains much dust and dirt and therefore is not advisable for radio work.

One teaspoon of powder dissolved in 10 parts of alcohol and allowed to stand

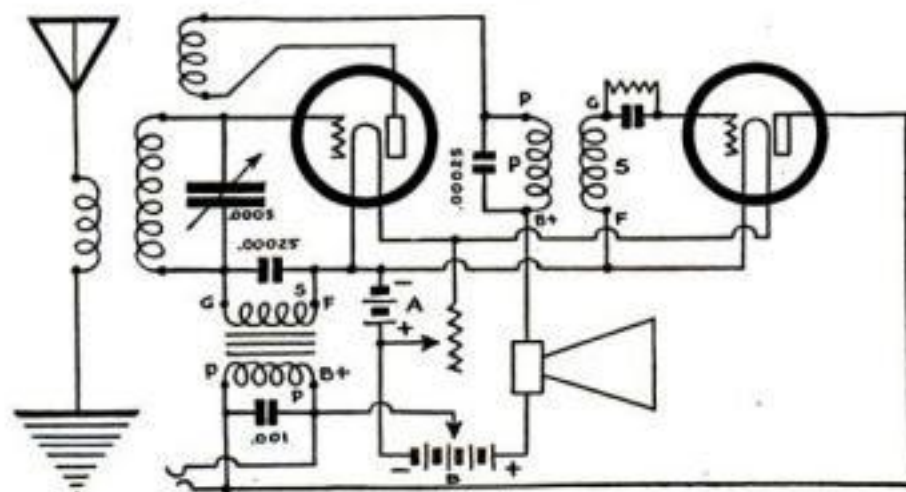
Two Sets in One for Long and Short Waves

ONE of the most unusual of the new feats of radio construction is a two-in-one receiver combining on a single panel a three-circuit honeycomb-coil set for long-wave reception, and a neutrodyne set for short-wave reception. The same set of tubes is used for both sets and two different programs can be heard simply by throwing the change-over switches.

The set is neatly and compactly constructed and is said to be very efficient. It was designed by Rutledge R. Mayo, of New York City, who is shown below with his instrument.



The two-in-one set and its builder



Wiring diagram that should be followed closely in building the set

a small core of iron will be necessary.

On the audio side, a transformer having a ratio of about 10 to one will give about the best results. A single-circuit telephone jack is connected across the primary of the audio transformer. This enables you to listen in with one stage of radio-frequency and the detector, the phones being connected across this transformer. You can tune in a station accurately while the loudspeaker is still in operation.

Longer Life for Dry Cells

How to Make Them Work Overtime—Useful Radio Hints

IF YOU use the large type of dry-cell vacuum tubes in your set, you probably have wondered often how you might make use of dry cells that you are forced to discard simply because the amperage has dropped below the minimum required to operate the tube. Almost always these cells have a good deal of "juice" left, which it always seems a shame to waste.

You can make use of the remaining current in the following way:

When you get a new set of four dry cells, instead of discarding the worn-out ones, store them away in a cool, dry place. Then in about six or eight weeks, when the new battery seems about ready to die, connect one of the old cells to make five cells in series.

Immediately you will see your battery take on new life. And when the five-cell combination gets too weak to work properly, add a sixth from your store of old ones; then a seventh and an eighth.

Finally when the eight-cell battery gives up, you will feel that you have your full money's worth and will be ready to throw the cells away. Before doing so, however, salvage the sealing-wax tops, breaking the material with a hammer.

Also pry off the brass screw connectors. Wax and screws both may come in handy later.

Thus you can make your batteries work to the limit for you and be satisfied that you have got the utmost from them.

a different color for each lead, perhaps as follows:

Red—30-volt positive B-battery wire. Red and white—22½-volt positive B-battery wire. Yellow—negative B-battery wire. Green—positive A-battery wire. Green and white—negative A-battery wire.

Remember that red and red and white indicate danger to your tubes.

FOR small soldering work about your set, soldering coppers to suit the conditions can be made from No. 4 copper wire. In one end of a three-inch length, drill a hole for the insertion of an iron handle wire. The other end can be sawed or filed to the shape desired—a point or a wedge.

Another way is to wind the copper wire around your soldering iron, letting the end of the wire extend beyond the point of the iron. The heat of the iron then will keep the soldering copper hot while the job is being done.



Here is a homemade loudspeaker that is very simple to construct. Lay one of the phones of your head set on the table, face upward. On this phone place a long, tubular tin horn about

18 inches long. Remove the light bulb from a reflector desk lamp, and place the reflector a few inches above the upper opening of the horn. The light reflector will act as a sound reflector

ACCORDING to recent estimates, more than 90 per cent of all vacuum tubes sold never live their full and intended life. Abuse and carelessness on the part of the users are given as the reasons why more than 9,000,000 tubes were sold last year.

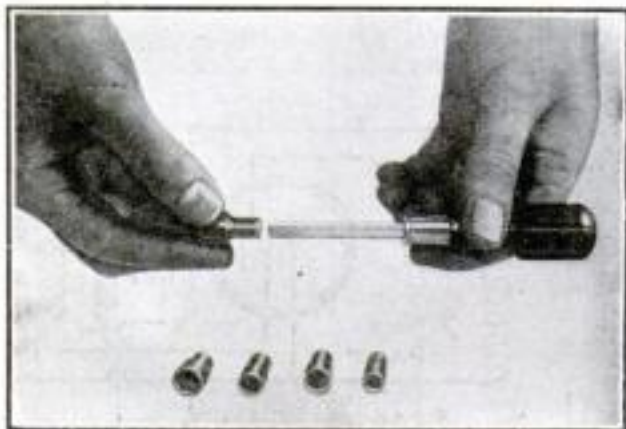
You can make your tubes live longer if you light the filaments just up to the point of required loudness and no more. If you turn them on full blast, they will burn out rapidly, causing weak and distorted signals.

To guard against the danger of blowing out your tubes by high voltage from the B battery, through an accidental short circuit, be careful to disconnect the positive wire of the B battery before changing wires or switching a tube.

If you are experimenting, it is a good plan to arrange a single-pole, double-throw switch somewhere on the table to open the circuit while making changes.

A DEFINITE color code for battery wires will aid you in distinguishing quickly between the various wires, and so may save you a lot of worry and expense. You can purchase bell wire with insulation in several different colors. Use

beyond the point of the iron. The heat of the iron then will keep the soldering copper hot while the job is being done.



For the man who builds his own set this five-in-one detachable socket wrench is an unusually handy tool, especially for tightening parts and connections. Five interchangeable sockets of various sizes fit over a handle resembling a long screwdriver in appearance

This extremely sensitive new German loop aerial can be folded into various shapes, offering varying degrees of selectivity, and thus making it a tuner

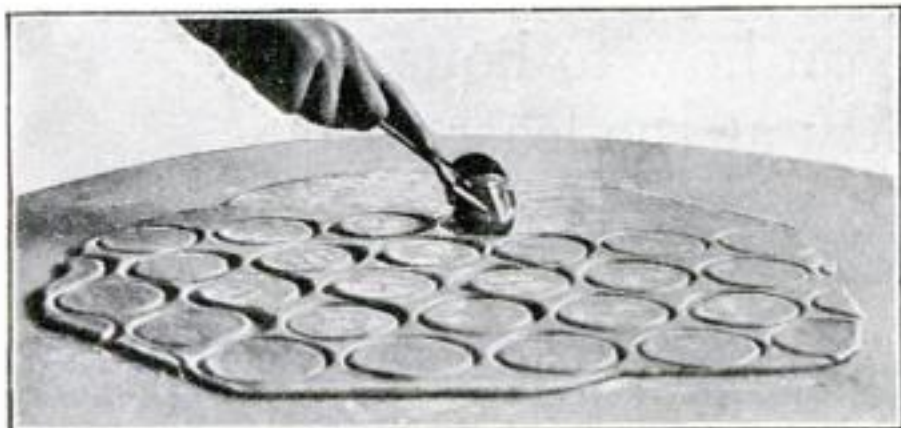


THE use of copper ribbon for aerials instead of ordinary solid or stranded wire is becoming increasingly popular with experimenters, because its large surface offers comparatively little resistance to the high-frequency currents.

One objection, however, is that it presents a flat side to the earth, and so acts as a condenser with fairly high capacity. To avoid this, the ribbon can be twisted like a stick of sugar candy, so that the flat surface is presented alternately. This cuts the capacity in half.

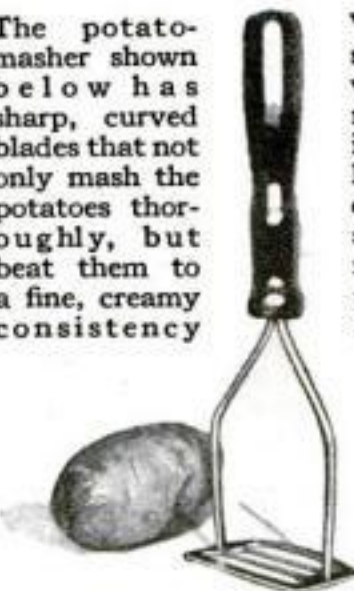
Keeping the Kitchen Up-to-Date

The Modern Housewife Studies Labor-Saving Devices



Made of heavy aluminum and easy to clean, this rotary biscuit-cutter is said to cut up biscuits, cakes, and cookies faster than the pastry-cook can count them

The potato-masher shown below has sharp, curved blades that not only mash the potatoes thoroughly, but beat them to a fine, creamy consistency



Women living in small apartments will welcome this miniature washing machine. It has one-sixth the capacity of a full-size washer and runs by water power. It is guaranteed for a year

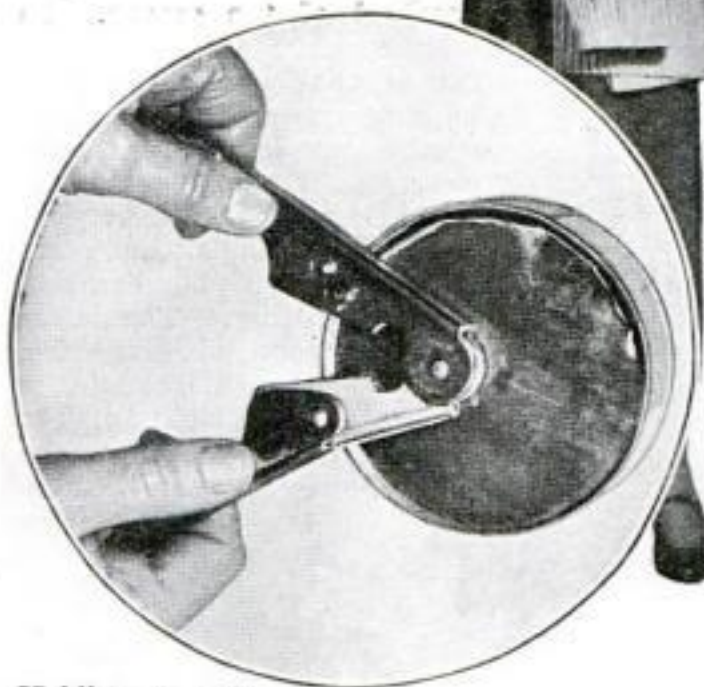


Easily adjusted, the door-rack at the left provides a hat or shoe shelf, eight hangers, a swinging bar for skirts and six hooks



This glass milk-bottle stopper fits any size, is sanitary, and will not break in hot water

These glass containers with ridged edges, are built to save space in the icebox

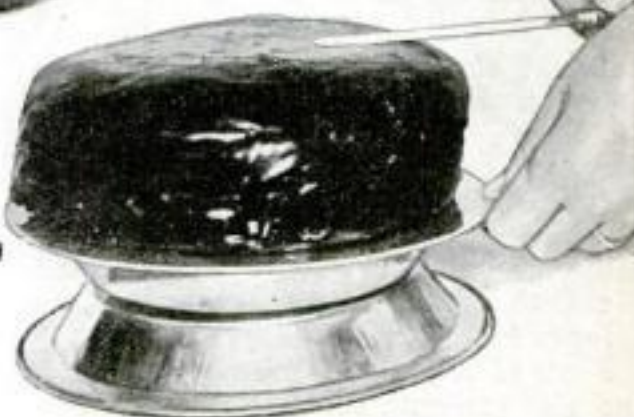


Holding a can between its jaws, this opener performs its duty without danger to the operator



Cutting fruit with silver was good enough until France sent us this stainless glass knife, which housewives will welcome

Below, at left, is a machine that fastens covers on tin cans, rendering them airtight. At right is a corn-cutter that cuts kernels off ears of corn for canning



Two pie-pans that pivot on each other form a revolving stand for icing cakes. When not used for that purpose, they may be used as two ordinary pie-pans

How to Build A Garage to Fit Your Car

An experienced architect tells you how to house your automobile most conveniently at the least cost

By G. Gouverneur Ashwell

A FEW years ago a private garage—that is, one maintained by an automobile owner to house the family car—was likely to be anything from a converted woodshed or chicken-coop to a remodeled barn or cottage. Now, though, that the automobile has become an essen-

garage, guided by the over-all measurements of his car. He failed, however, to consider his front and rear bumpers. As a result, he couldn't close his garage doors.

He thought it would be necessary for us merely to remove the rear wall of the

or more from adjoining property, and, since this garage already was three feet from the property line at the rear, we had to make the addition at the front of the building.

SIMILAR requirements are made by the fire department or building department of virtually every town and city of the United States, so, if you contemplate building a garage, be sure, before the work is begun, that either you, or your architect or builder, submit the plans to the local building authorities for approval. This will save you from possible trouble later on.

Now, as to the size a garage should be. A Ford touring-car or sedan will fit comfortably in a space 12 feet long, five feet six inches wide, and six feet six inches high. Medium-priced cars vary in length from 15 to 17 feet; a Packard Standard Eight is 16 feet 10 inches long; a Cadillac, 16 feet. The medium- and higher-priced cars are about six feet in width and something less than seven feet high.

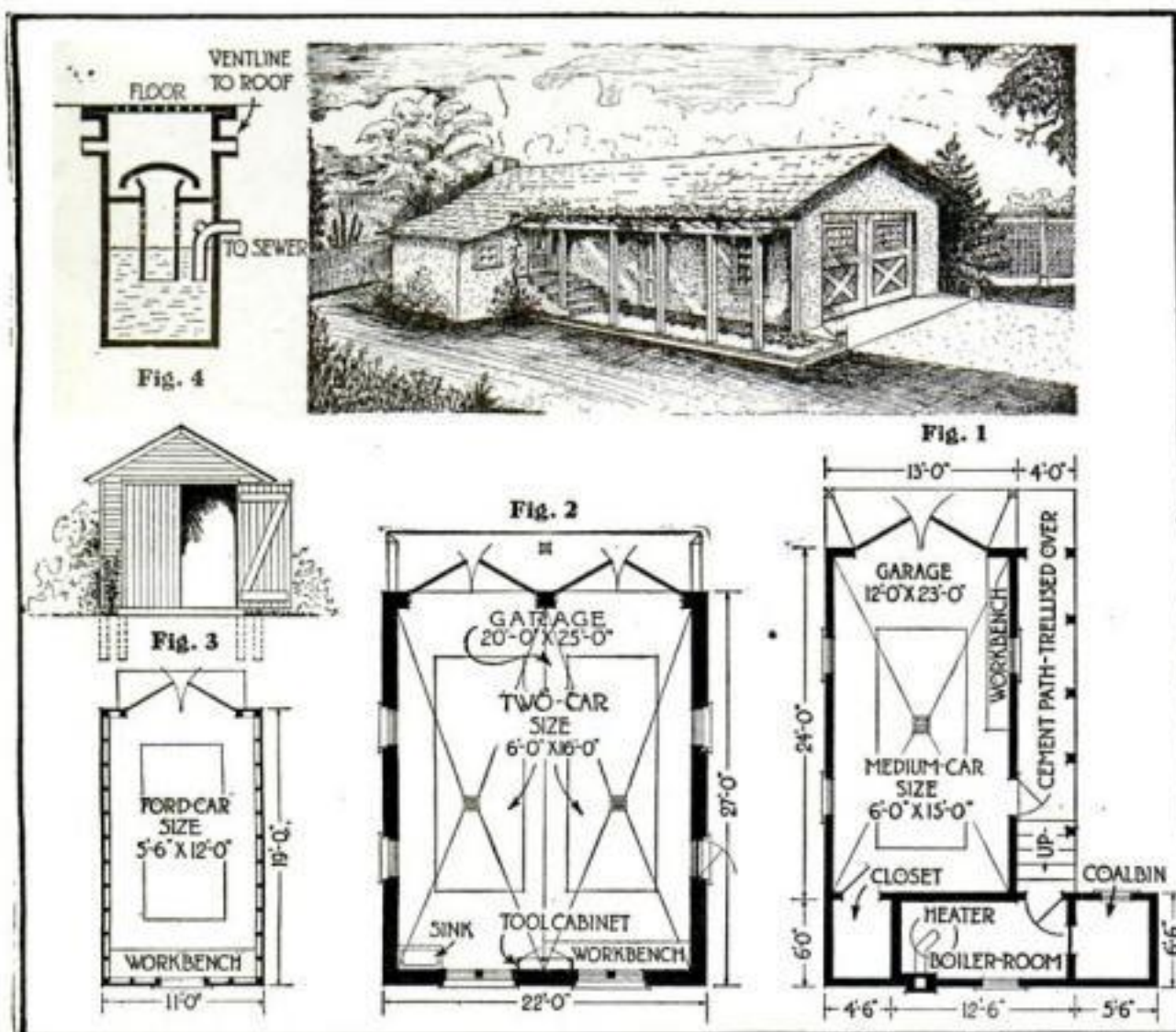
However, it would require more than expert aim to get any of these cars in or out of a garage the dimensions of which are exactly those of the car, without tearing off a mudguard or carrying away a doorpost of the garage. In other words, a close fit for your car is not to be sought in building your garage. You must allow plenty of room for clearance.

A safe rule is to make your doorway opening at least two feet wider than your car, and two feet higher. The latter part of this rule, though, is elastic, for the height of the doorway must be increased if the runway leading from your driveway to the garage floor level is steep, or if you are in the habit of carrying articles on the roof of your car.

The doorway of a one-car garage should rarely be less than nine feet in width. For Fords, 7½ feet will suffice in a pinch; for other cars 8½ feet may do; but for all cars

the nine-foot doorway is decidedly best.

You can, of course, make the interior of your garage the same width as your doorway. Be sure, though, that you allow sufficient space to get in and out of



Plans, prepared by the author, showing three types of garages. Which fits your needs best? Fig. 1 shows a very complete, but comparatively costly, garage for the medium-sized car. It is equipped with its own heating plant, as shown in the floor plan directly below the sketch. Fig. 2—Floor plan for a two-car garage. Fig. 3—Sketch and plan for small-car garage. Fig. 4—Plan of floor drain, with pipe to sewer and ventline to carry fumes to roof

tial part of the home—a sort of living-room on wheels—we house our cars in buildings constructed exclusively for that purpose and supplied with conveniences that make the operation of a car more pleasurable and its care less of a task. More, we build our garages in good taste so that they increase, rather than mar, the appearance of our homes.

First of all, a garage must be large enough to accommodate the car that is to occupy it. That may seem like an unnecessary statement; yet only a few weeks ago a man called at my office to ask me to prepare plans for the enlargement of his garage. He had bought a new home, and had attempted to construct his own

building and add an extension, but I found upon consulting the building inspector of the town that this was quite impossible. The local building ordinances required that garages be placed three feet



How a small-car garage was expanded to make room for a larger car. Rather than go to the expense of extending the size of the whole building, the owner simply built a small addition at the rear, where less head room naturally is required when the car is run in. Incidentally, the addition provides a support for the radio aerial mast

the car and walk around it in comfort. An inside width of from nine to $9\frac{1}{2}$ feet is essential for this; while from 10 to 12 feet is better still, for in most garages space must be provided for the storage of garden tools, hose reels, lawn-mowers, baby-carriages, children's bicycles and wagons and similar appurtenances of family life.

THE minimum length of a garage for practicability is two feet longer than the over-all length of your car, including bumpers. However, as in the case of the width, it is poor policy to figure too closely. An extra two feet in length to allow for a workbench will prove a great convenience. You also will add to your convenience if you place a door, two feet six inches in width and six feet eight

or locust, from $2\frac{1}{2}$ to $3\frac{1}{2}$ feet into the ground, depending on the depth of the frost line. If brick or concrete is used for piers, they should be eight inches square. The posts should be placed from three to four feet apart and protrude from six to eight inches from the ground. One post should be at each corner and one under each doorway post. Nail boards to the inside of these all around from ground to top, saw off the tops level and square. Fill the floor from four to six inches deep with cinders or broken stone; tamp, wet down, and roll well.

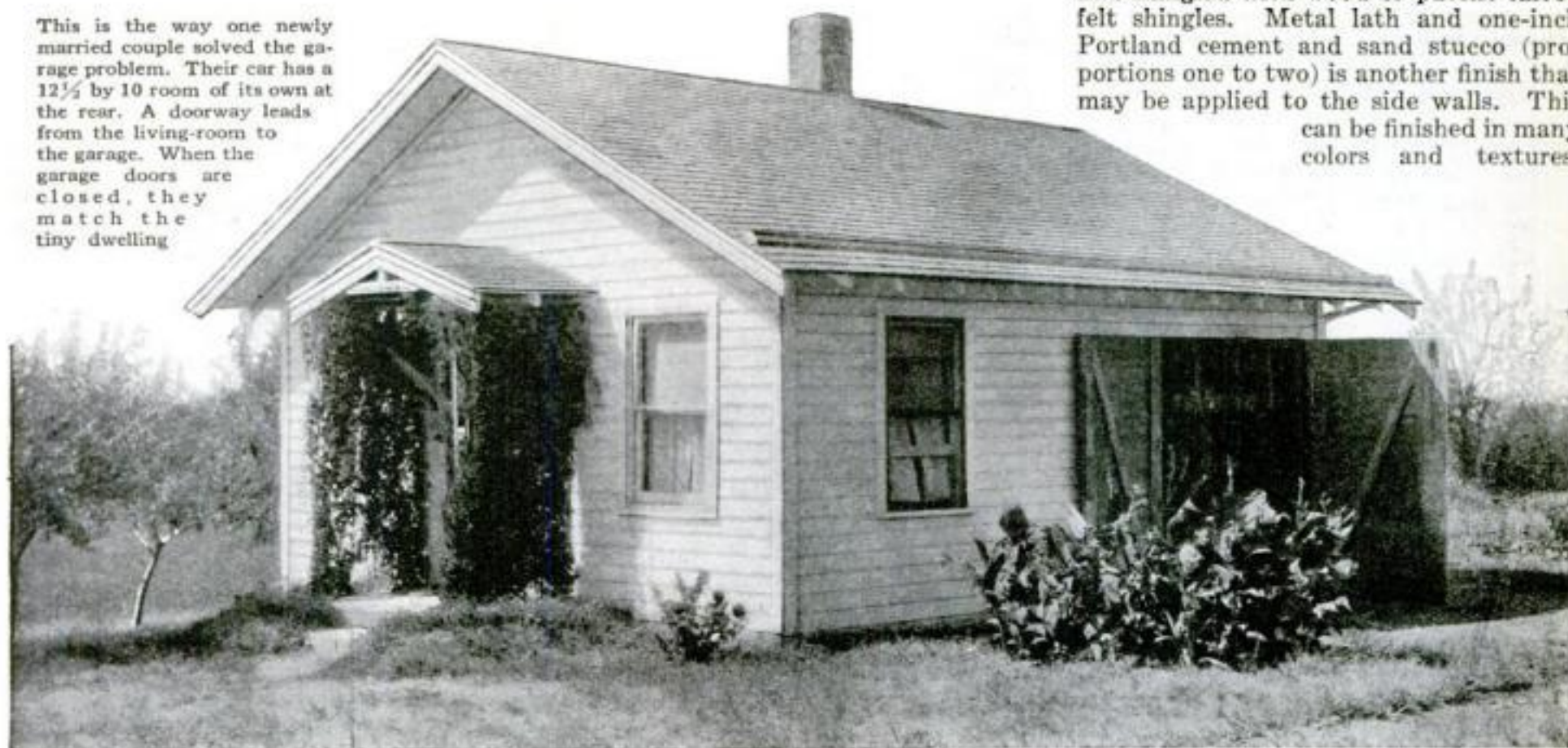
On the posts or piers, except those at the main doorway, nail a two-by-four—better a four-inch-square spruce or hemlock plate. On this erect four-by-four door and corner posts and two-by-four stud-

seven-eighths inch by six inches will do for a rafter ridge.

The rafters may be covered with a seven-eighth-inch tongue-and-groove boarding, and this covered with good grade tar felt, asphalt, or patented roofing, in rolls or shingle effect, or the roof may be shingled with wood or asbestos shingles, laid on seven-eighths by two-inch shingle lath. The rafters should hang over the walls at least 12 inches.

THE side walls may be covered with novelty or beveled siding, directly on studs, or with seven-eighth-inch sheathing boards and building paper beneath, the latter being tighter and warmer, but costing more. Or the studs may be covered with seven-eighth-inch boarding and shingled with wood or patent tarred felt shingles. Metal lath and one-inch Portland cement and sand stucco (proportions one to two) is another finish that may be applied to the side walls. This can be finished in many colors and textures.

This is the way one newly married couple solved the garage problem. Their car has a $12\frac{1}{2}$ by 10 room of its own at the rear. A doorway leads from the living-room to the garage. When the garage doors are closed, they match the tiny dwelling



inches high, opening outward, in the side wall opposite the driver's seat. This door should have a glass upper half panel.

There should be one window in this wall, two in the other side wall, and at least one in the rear wall. Plenty of natural light will make it easier for you to work around your car and also save you money in electricity; for, if possible, your garage should be wired for electric light. Also it will be just that much better if it has a cement floor and runway, drainage, heat, and water supply.

HOWEVER, the first purpose of a garage is to supply adequate shelter for a car, and if it fulfils that purpose, many other details may be dispensed with, at least until you feel you can afford them.

The least expensive type of garage resembles an old-time shed or farm-wagon house. A garage of this kind you can build yourself, if you are handy with tools, at a total cost of from \$50 to \$100, depending on prices in your locality and the kind of materials you select. If you have not time to attempt the work yourself, you must add four or five days' carpenter labor to the cost of materials. Since the construction of this type of garage is fairly typical of all, I will describe it briefly.

Sink six-inch posts of chestnut, cypress

ding, eight feet long, from 18 to 20 inches on centers. Top off the studding with a four-by-four rafter plate. Rafters may be two-by-six, or, if the snowfall is light, two-by-four, set 18 inches on centers. Two-by-four tie beams, four feet apart, must cross the garage from the top of plates and be spiked to rafters. A board

Points to Remember

MAKE the opening of your garage doorway at least two feet wider than your car, and two feet higher.

Be sure your garage is at least two feet longer than the length of the car, including bumpers.

See that you have good ventilation, especially in the built-in garage, to safeguard you against the danger of gasoline fumes and poisonous carbon-monoxide gas from the exhaust.

Beware of open heating plants, such as gas, oil, or coal stoves.

Take care to comply with building and fire ordinances of your city or town.

Dressed pine or cypress, $1\frac{1}{8}$ inch by two, should be used for doorway trim and at corners if siding on walls is installed.

For doors, plain battens, similar to the conventional barn doors, should be used. These can be constructed of seven-eighths by six-inch tongue-and-groove boarding, with three battens, $1\frac{1}{8}$ by eight inches, on back of each door—one across the top, one across the bottom, and one diagonally from top to bottom. Heavy iron strap hinges should be used.

PAINTED to match your house and partially screened by shrubbery, a garage of this sort will fit into almost any neighborhood. A light cornice of simple stock moldings along the eaves and up the gables will improve its appearance but add to the cost. Windows, a cement floor, and similar features may be included if desired.

Although this type of garage will house any car satisfactorily, if constructed in proper size, it is particularly adapted to the Ford or other light car.

Probably a more substantial type of garage will be desired, particularly by persons who own medium-priced or high-priced cars. The floor space in a garage of this kind should be not less than 10 by 22 feet for one car, or 20 by 25 for two, although 12 by 25 and 24 by 25 are better.

(Continued on page 161)

When Your Engine Misses

It may be faulty ignition—What to do and how to do it—An expert's time- and labor-saving hints for your car—Vital parts of the ignition system and how to test them

By George A. Luers

"I'M DISGUSTED with my car," a friend of mine said to me the other day. "And it's all because the spark plug of one cylinder persists in getting fouled. Yesterday while I was out driving I had to replace the plug in that cylinder four times in 20 miles. The fifth time the plug fouled I had run out of spares, and the only thing left to do was to take it apart on the road, clean it, and replace it."

One hardly could blame this motorist for being out of sorts with his car. In an effort to find and remedy the trouble, he had spent considerable time and money, apparently in vain. He had a new piston fitted to the troublesome cylinder and the piston refitted with special oil seal rings. In addition, the cylinder had been reground.

A FEW days after he recited his troubles to me, my friend, quite by chance, met an electrical mechanic to whom he told the same story. The mechanic became interested enough to examine the engine. Inspection showed that all electrical terminals were in good contact, and that all the units of the ignition system apparently were functioning properly. By the process of elimination, he decided that the trouble must lie in the only vital moving part of the circuit—the circuit-breaking mechanism.

And here the whole disturbance was traced to an unusual cause. The cam operating the circuit breaker was found to be worn at its extreme end. Whenever the engine was speeded up, this worn spot failed occasionally to close the circuit, causing the engine to miss. Thus one small worn spot that could be remedied for about a dollar had resulted in a lot of unnecessary work and expense for repairs.

I have recited this experience simply to point out the importance of gaining a working knowledge of the ignition system of your car. For while the ignition sys-

tem is equally, if not more, important than the fuel system, its difficulties are more elusive. A leakage of fuel becomes evident immediately, whereas a leakage of electric current, while fully as vital, may not be detected unless you are acquainted with the various faults and troubles to which an ignition system is subject.

The usual ignition circuit consists

parts, or in the connecting wires, will interfere immediately with the proper firing of the cylinders, and it will be necessary to repair the trouble to obtain satisfactory operation of the engine. What repair to make depends upon your ability to trace the ignition current from its source to the final operation in firing the cylinder charge.

To test the primary circuit—the low-voltage circuit from the battery to the coil—a small test lamp or ammeter generally is used, while a spark gap is a method of testing the flow of secondary current, which is the current from the coil to the spark plugs. The spark gap, which is simply an opening in the circuit, can be obtained by removing a plug terminal about an eighth of an inch from the top of the plug.

The purpose of such systematic care of the ignition system is to maintain the original condition of the circuit. In other words, it is to see that all terminals are clean and tight, that the wires are free of breaks or abrasions, that the circuit breaker is in adjustment, that the switch is making positive contact, that the coil is dry and secure, the distributor parts intact, and the spark plugs in good condition.

BEGIN with the battery terminals. These become sulphated and must be cleaned, tightened, and coated with vaseline periodically.

The battery wire should be inspected for abraded sections and protected with strips of

linen or cloth shellacked over any worn places.

Where any wires are adjacent to metal, it is advisable to tape them. Where they are in the vicinity of the engine, where oil would reach the tape, they should be wrapped with a shellacked strip of cloth that will not loosen when oil comes in contact with it.

The ignition switch on the dash should

What to Look for when Your Ignition System Fails

BELOW is a list of the things that may cause the ignition system of your car to go wrong. It was compiled by Mr. Luers from a long study of service-station repairs.

Cut out this list and tack it up in your garage for ready reference. It may save a lot of time and expense.

Here are the troubles to look for:

- Disconnected terminal or wire.
- Spark-plug gap too wide or closed.
- Oil, water, or dirt in circuit breaker.
- Water or "short" in distributor cap.
- Grounded primary wire.
- Wear or weak spring in the circuit breaker.
- Distributor cap loose or displaced.
- Pitted or defective contacts on circuit breaker.
- Breaker contact points out of adjustment.
- Ground in secondary wiring.
- Spark plugs dirty or carbonized.
- Spark-plug porcelain cracked.
- Defective coil.
- Defective contact at ignition switch.
- Leaking secondary cables.
- Ground through armored cable.
- Spark timing incorrect.
- Broken wire inside insulation.
- Spark-plug wires misplaced.

essentially of the following units, which are shown diagrammatically at the foot of page 89:

- Current source, battery, or generator.
- Switch.
- Circuit breaker.
- Coil.
- Distributor.
- Spark plugs.
- Difficulties or breakage of one or more

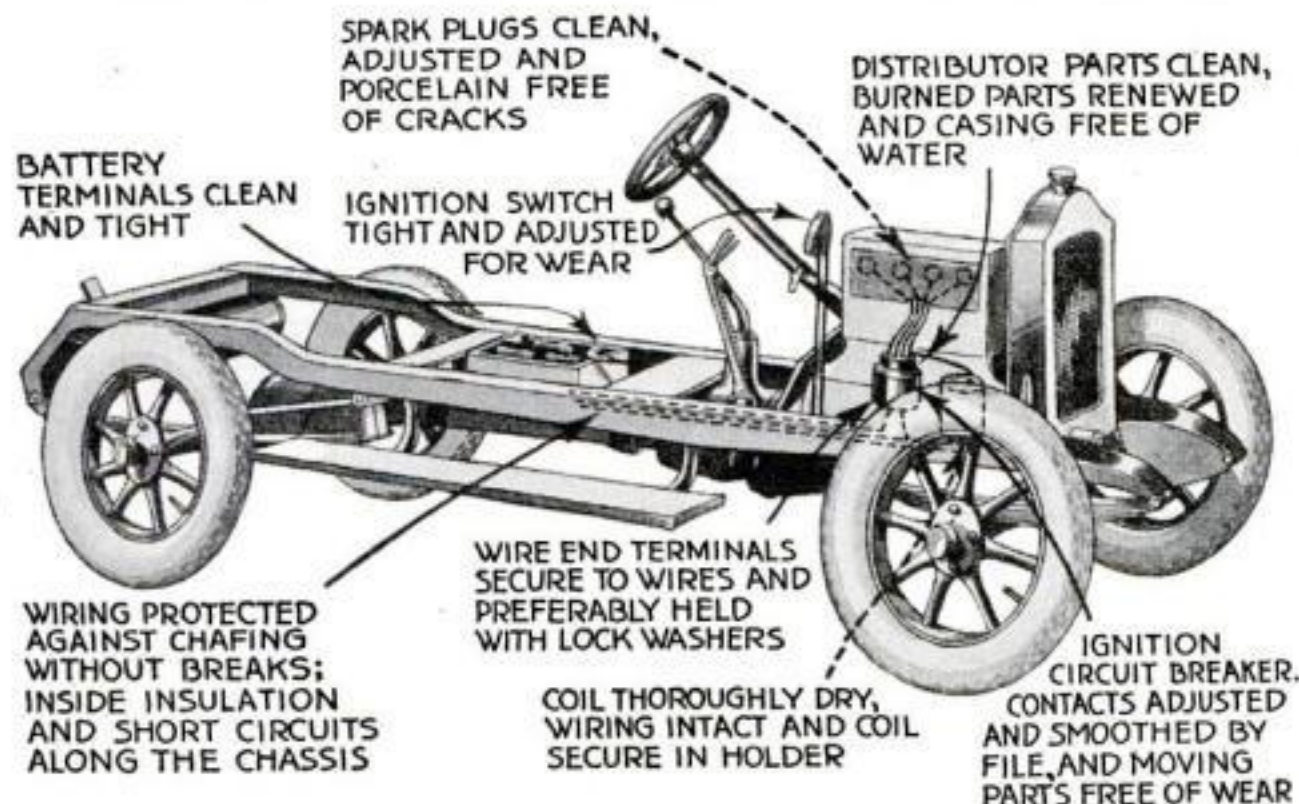
be tightened, using a screwdriver and pliers to set up the small screws and nuts. The nuts of all terminals have a tendency to become loose, due to the vibration of the engine. Small lock washers such as are used on spark-plug central electrodes are serviceable guards against the nuts' backing off.

See that the circuit breaker is in

going over the system, it is well to examine especially the portions that have been bent. An inside break of the wires can be felt through the insulation with the fingers. Armored wires are subject to "shorting," due to the fact that the armor sometimes will cut into the insulation. This condition can be determined by use of a test lamp. The remedy is to cut

Absence of spark indicates a possible ground in the breaker mechanism, defective contact points, a weak breaker-arm spring, or other faults inside the breaker.

An open circuit in the ignition switch may be revealed by an absence of sparking when the wire is removed from the circuit breaker and touches the frame or engine. Another way is to "short" the switch by means of a wire from the battery terminal of the switch to the ignition wire leading to the circuit breaker. When this connection gives ignition current, the switch is faulty and requires repair.



This diagram shows the important points to look out for in overhauling the ignition system of your car. Systematic attention to these items will maintain the circuit in good working condition

adjustment and that the contact points will snap in and out of contact with the movement of the breaker cam. The contact points should be separated a distance of at least a thirty-second of an inch.

THE points are made either of tungsten or platinum, and these must be made flat and even, free of ragged ends or pit marks, and rubbed with a Swiss or jeweler's file between the ends. The metal is thin and for that reason excessive filing must be avoided.

Wear of the roller, cam, or moving parts inside the igniter circuit breaker should be subjected to careful inspection. Frequently small particles of metal will be found inside the case, and this condition should be noted as a possible cause of future trouble. No attempts should be made to open the coil. The only work required here is that of making the contacts tight and also tightening the coil holder, for the holder is frequently a ground connection, and when loose will interfere with ignition.

The distributor rotor gradually will be burned away, though this condition will be found only after long use. The distributor cap requires little attention except to make sure that the snap fasteners and positioning pin hold the cap solidly against the distributor case and give the cap its proper relation to the rotor.

Spark plugs should be cleaned occasionally and inspected for cracks in the porcelain. The points should be adjusted to compensate for the metal burned away in use. The gap of the plug should be set at one thirty-second of an inch. This close gap will allow for the burning away of some metal without the necessity of adjustments.

All wires are subject to possible breakage from bending. For that reason in

the armor back and tape up the broken area.

The best methods of testing ignition units, and so saving yourself repairs and replacements, are as follows:

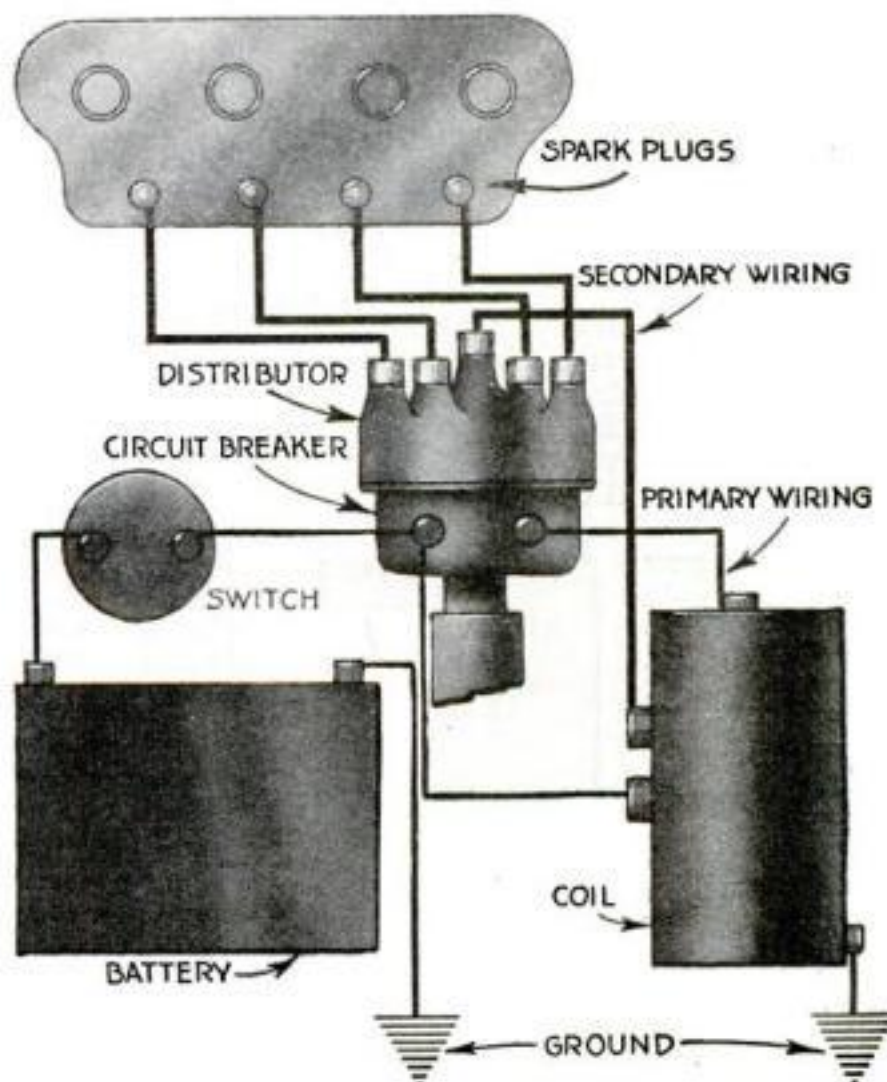
To test the coil, attach one end of a wire to any part of the engine or car frame and bring the other end to within three-sixteenths of an inch from the attachment of the high-tension wire leading to the rotor of the distributor. When the engine is cranked by hand, a spark occurring at this place indicates that the coil is in good condition. Where the ignition circuit up to this point is intact and no spark occurs, the coil is defective and should be replaced.

THE first step in testing the ignition circuit breaker is to try out the ignition circuit up to the distributor by disconnecting the wire and testing it for sparking against the frame or engine. A spark will indicate that current is reaching the breaker. Revolve the motor to close the contact points in the breaker, and after replacing the removed wire, disconnect the wire leading to the coil. Strike the terminal end of this wire against the terminal of the coil.

WHERE the coil test shows that current is delivered to the distributor wire, failure to deliver to the spark plugs is due to some fault in the distributor, such as water, burned contacts, or short circuit in the rotor. Removal of a spark-plug wire while the engine is turned by hand or by means of the starter, will show whether the current is delivered to the plug. If the distributor is water-soaked, dry it inside and out. If the rotor and contacts are burned away, replace parts. A cracked distributor cap with water in the crack sometimes will lead the current to ground, and so break the circuit.

I believe that if you will follow these suggestions, first studying the ignition system to gain a thorough knowledge of its operation, then taking systematic care to keep the circuit in good condition, and finally, if anything goes wrong, applying the simple tests I have described, you will find that your car will give you better, more consistent service at less expense.

ADDITIONAL information on how to time the ignition system will be found in a useful article by Ray F. Kuns in the Home Workshop Department, page 126 of this issue.



Units of the complete ignition system and their wiring. Study of this diagram in connection with the accompanying article will give you a new knowledge of how the system works, and so will aid you in locating any troubles that may arise in your auto engine

How to Cut Your Car Costs

Keeping an Auto

in Good Condition

ONE cold winter morning, when Johnston stepped on the starter of his car, the engine hesitated momentarily, although it finally turned over and began to run. The radiator that morning was frozen, but Johnston attributed this to running the car out in the cold. For several months afterward he noticed that on long-continued runs the engine boiled. Finally, when the car was placed in the repair shop, he learned that the retaining pin of the pump rotor had been sheared.

Unquestionably this had happened on the frosty morning when the radiator was found frozen. The car had been driven continuously since that time with the pump failing to deliver any circulation.

Johnston then made use of two simple methods (Fig. 1) for testing whether the pump rotor is broken or if the radiator is frozen.

Two holes are tapped through the pump casing directly opposite the hub where the shear pin is placed, and small pipe plugs are set into them. By removing the upper plug it is possible to determine if the pump propeller revolves with the shaft whenever the car shows signs of overheating, and the removal of both plugs makes it a simple matter to renew the dowel pin quickly.

The test for freezing is made by pressing between the fingers the lower rubber hose connection to the radiator. When frozen or partly frozen the hose does not collapse readily and it is necessary to thaw it out.

A SIMPLE method for making the choker rod on light cars self-retaining is to cut notches in the rod with a hacksaw blade (Fig. 2). This may be done while the rod is held out by hand or after it has been removed. The notches will engage the lower edge of the hole through the dash, thus holding the choker rod in any one of several positions. Six notches are sufficient for all ordinary purposes.

WHEN new piston-pin bushings are purchased by a car-owner he often has trouble both in extracting the old bushings and inserting the new ones. The simple tool shown in Fig. 3, however, makes this work easy.

A bar $\frac{3}{4}$ by $1\frac{1}{4}$ by 6 in. is drilled and tapped to take a $\frac{5}{8}$ -in. screw. This screw is about 5 in. long with a crank fitted to it either by welding or forging. A plug is turned as shown, so that its larger diameter will

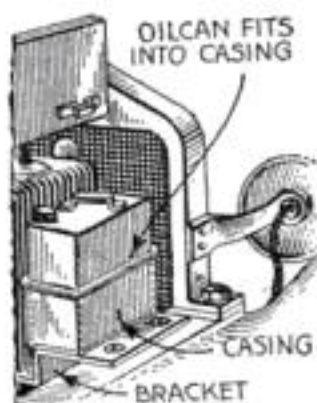


Fig. 6. Oilcan carrier

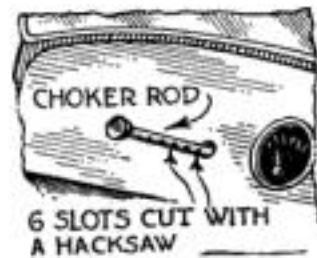


Fig. 2. Slotted choker

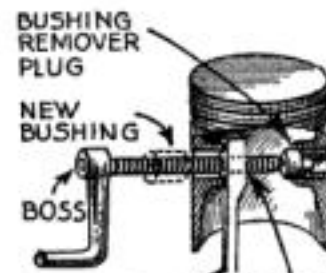


Fig. 3. Bushing tool

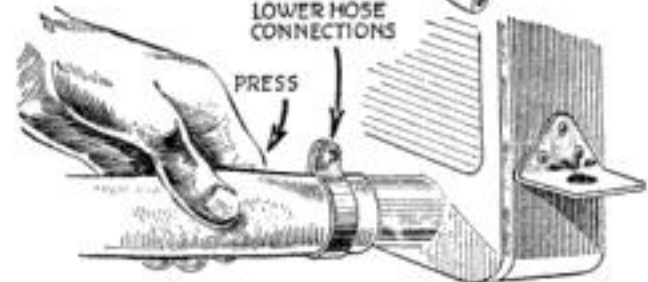
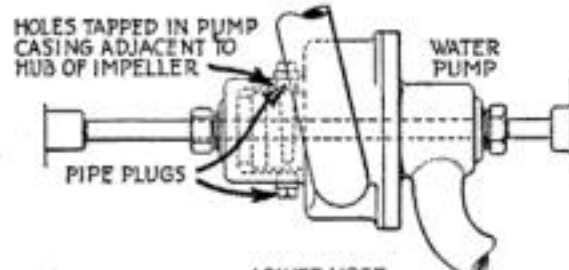


Fig. 1. Cold-weather tests for water circulation

These are kinks that every autoist should know.

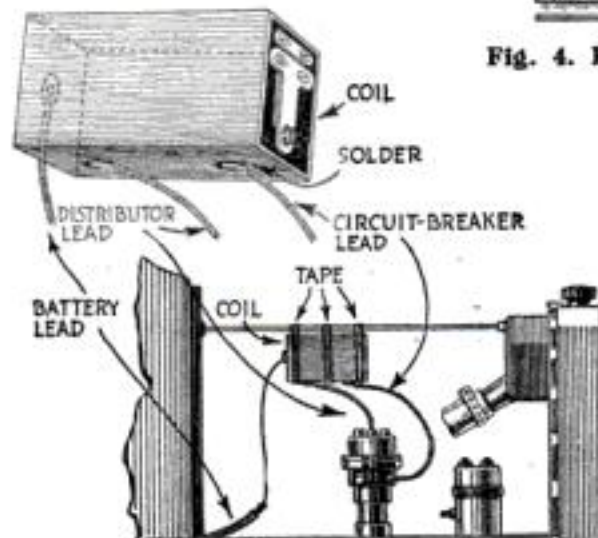


Fig. 5. Substitute for burnt-out ignition-coil

pass through the hole in the piston into which the bronze bushing fits. The smaller part of the plug is made the size of the piston pin.

To remove a bushing, the tool is set as indicated and the screw turned by means of the crank. A new bushing is inserted by placing it over the screw before the latter is started in the threaded bar. Turning the crank then forces in the bushing.

A boss should be provided where screw and crank unite so that a stubborn bushing may be started by tapping against the boss with a hammer after pressure has been applied with the screw.—GEORGE G. McVICKER, North Bend, Neb.

IF A reamer is not at hand for fitting a new piston pin or bushing, place the new pin in the new bushing and, after removing the old bushing, drive the two into the connecting rod or piston, as the case may be. Placing the pin inside the bushing prevents the bushing from becoming distorted.

Drive out the pin and see if the old pin will start into the new bushing. If it will not, grind one end carefully until it will. Then work some grinding compound into the bushing from both ends, turning the pin around and around. Use only one end so that the pin gradually will become tapered. In this way you can grind the bushing to any desired size.

Clean out the compound at intervals and try the new pin. A little oil on the new pin will allow a closer fit than if the pin is dry. This will give a very smooth and perfect fit.—E. B. STAPLES, Eureka Springs, Ark.

IF YOU should happen to be driving a Ford in the country and a spring-shackle bolt snapped, what would you do? If you have a spare inner tube, take out a valve stem and insert it in place of the broken bolt (Fig. 4). The writer has witnessed this very simple repair and the substitute bolt is still in place after several months.—SAMUEL HAGERMAN.

WHILE touring recently, a friend of mine burned out the ignition coil. The only repair man in the neighborhood had nothing but a few spare parts for light cars, yet he fixed the ignition system fairly well with a substitute coil. This was made from one of the small box coils that are used in combination with the magneto ignition of small cars.

Three insulated wires were soldered to the contact points on the coil casing and connected, as shown in Fig. 5. The distributor connection was made with a high tension wire. The vibrator of the coil was bridged by screwing the contact points solidly against the core of the coil.

AFTER twice losing a gallon of oil when the can overturned in its place under the engine hood, one motorist made up a rectangular shaped casing as shown in Fig. 6. This just fits the can of oil.

It not only safeguards the oil, but also prevents the can from jolting against the carburetor, generator, and adjoining parts.

TO REMOVE the magneto terminal from a car equipped with the flywheel type of magneto, requires a short

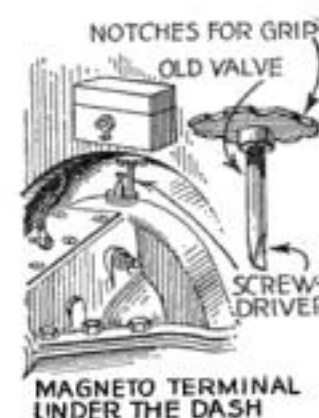


Fig. 7. Short screwdriver

special type of screwdriver, unless the engine has been removed from the car. A special screwdriver to serve this purpose may be made quickly and cheaply from an old valve, as shown in Fig. 7.



The Home Workshop

tor

Christmas Tree Mountain

Upon which to build the tree may be made of boards, a wallboard, several thicknesses of heavy wrapping-paper, or a furniture cover. The covering that will protect the tree will do. On the center of the base a box to support the tree and mountain foundation. The Christmas tree should be set up until the model is complete.

The lower photograph suggests the construction of a foundation of wallboard for the mountain. Heavy cardboard such as is used for food boxes may be substituted. Your own supply of these cartons, or cardboard and fiberboard can be cut with a saw.

The general shape of the foundation should be that of the lower part of a frustrum of a four-sided pyramid. Portions of the sides may be cut away as shown for entrances, for chasms and formations. And foundations for peaks may be built of triangular-shaped pieces added to the base as indicated.

The joining edges of the wallboard or fiberboard may be fastened together with strips of paper or more conveniently handled with passe-partout paper used in mounting pictures, or gummed paper for sealing packages. Upon the surface you may indicate in pencil the trails, gulches, and peaks shown in the surface modeling. The leading trail indicated upon the photograph.

There should be water, if nothing more than a mountain pool in a valley with precipitous walls rising on either side, such as is shown in the foreground of the photographs.

All there is to setting up the

The surface modeling will be as easy, and fascinating work.

The plaster is dipped in a solution of water. The modeling is done in water.

As the plaster hardens it is not to mix not more than a

make it of a consistency of cream. Tear news-

convenient size for the pieces, and press into

while

A Bookcase Easy to Make

Requires Few Tools and Little Woodworking Knowledge

IF YOU have not had much experience in woodwork, you will find the bookcase illustrated one of the few really attractive and useful pieces of furniture that you can construct without a single difficult joint. The parts are put together with butt joints such as are used in making common boxes; there is not a dowel, a mortise and tenon, nor a dovetail anywhere.

The unique methods by which the construction has been simplified are not apparent, however, in the finished bookcase. The design is good and will stand comparison with the better class of bookcases sold in furniture stores.

The working details were prepared by George F. Kaercher, the furniture factory superintendent and nationally recognized authority on cabinet work, who has prepared the majority of POPULAR SCIENCE MONTHLY's furniture blueprints. If these drawings are studied in conjunction with the cutting list below, the size and relation of the parts will become so clearly apparent that there will be little danger of error.

A Top of case, $\frac{3}{8}$ by 11 in. by 3 ft.; 1 required

B Ends of case, $\frac{3}{8}$ by 10 $\frac{1}{2}$ in. by 4 ft. 10 $\frac{1}{2}$ in.; 2 required

C Shelves, $\frac{3}{4}$ by 9 $\frac{1}{2}$ in. by 2 ft. 8 $\frac{3}{4}$ in.; 4 required

D Bottom of case, $\frac{3}{8}$ by 9 $\frac{1}{2}$ in. by 2 ft. 8 $\frac{3}{4}$ in.; 1 required

E Door stiles, outside, $\frac{3}{8}$ by 2 $\frac{1}{4}$ in. by 4 ft. 3 $\frac{1}{2}$ in.; 2 required

F Door stiles, center, $\frac{3}{8}$ by 2 $\frac{9}{16}$ in. by 4 ft. 3 $\frac{1}{2}$ in.; 2 required

G Door rails, $\frac{3}{8}$ by 2 $\frac{1}{4}$ by 11 $\frac{3}{4}$ in.; 4 required

H Door astragal, $\frac{3}{8}$ by $\frac{3}{4}$ in. by 4 ft. 3 $\frac{1}{2}$ in.; 1 required

I Rail at top of doors, $\frac{3}{8}$ by 3 in. by 2 ft. 8 $\frac{3}{4}$ in.; 1 required

J Rail at bottom of doors, $\frac{3}{8}$ by 3 $\frac{1}{4}$ in. by 2 ft. 8 $\frac{3}{4}$ in.; 1 required

K Back of case, $\frac{3}{8}$ in. by 2 ft. 8 $\frac{3}{4}$ in. by 4 ft. 10 $\frac{1}{2}$ in.; 3- or 3-ply stock; 1 required

L Back stops, $\frac{3}{8}$ by $\frac{1}{2}$ in. by 4 ft. 3 $\frac{1}{2}$ in.; 2 required

M Top filling, 1 $\frac{1}{2}$ by 1 $\frac{1}{4}$ in. by 2 ft. 8 $\frac{3}{4}$ in.; 2 required

N Baseboard, $\frac{3}{8}$ by 3 $\frac{1}{4}$ in. by 2 ft. 8 $\frac{3}{4}$ in.; 1 required

O Baseboard returns, $\frac{3}{8}$ by 3 $\frac{1}{4}$ by 10 $\frac{1}{4}$ in.; 2 required

P Top filling returns, $\frac{3}{8}$ by 3 in. by 2 ft. 8 $\frac{3}{4}$ in.; 2 required

Q Base filling returns, $\frac{3}{8}$ by 2 in. by 2 ft. 8 $\frac{3}{4}$ in.; 2 required

R Feet, front, $\frac{3}{8}$ by 4 by 4 in.; 2 required

S Feet, back, $\frac{3}{8}$ by 2 by 4 in.; 2 required

T Top back board, $\frac{3}{8}$ by 11 $\frac{1}{4}$ in. by 4 ft. 10 $\frac{1}{2}$ in.; 1 required

U Top back board, by 10 in. veneer; 2 required

V Top back board, by 11 $\frac{1}{4}$ in. by 4 ft. 10 $\frac{1}{2}$ in.; 1 required

W End of case, $\frac{3}{8}$ by 10 $\frac{1}{2}$ in. by 4 ft. 10 $\frac{1}{2}$ in.; 2 required

X Feet, front, $\frac{3}{8}$ by 4 by 4 in.; 2 required



The Home Workshop

for

is Tree Mountain

Upon which to build the tree may be made of boards, a wallboard, several thick-boards of heavy wrapping-paper, fly, or a furniture cover. A covering that will protect the model will do. On the center of the base a box to support the tree and mountain foundation. The Christmas tree should be set up until the model is complete.

The lower photograph suggests how to build a foundation of wallboard or the mountain. Heavy cardboard such as is used for food boxes may be substituted. Your own supply these cartons. Cardboard and fiberboard can be cut with a saw.

The general shape of the foundation should be that of the lower frustum of a four-sided pyramid. Portions of the sides are cut away as shown for entrances, for chasms and formations. And foundations for peaks may be built of arched pieces added to the base as indicated.

Joining edges of the wallboard or fiberboard may be fastened together with strips of paper or more conveniently handled passe-partout paper used in mounting pictures, or gummed paper sealing packages. Upon the surface you may indicate in pencil the trails, gulches, and peaks desired in the surface modeling. A winding trail indicated upon the surface in the photograph.

The surface should be water, if nothing more than a mountain pool in a landscape with precipitous walls rising from the sides, such as is shown in the background of the photographs.

All that is left to setting up the model is to setting up the

The surface modeling will be

found just as easy, and fascinating work. Newspapers dipped in a solution of plaster of Paris in water is the modeling material to use. As the plaster hardens rapidly, it is best to mix not more than a pint at a time. Make it of a consistency a trifle thicker than cream. Tear newspapers into pieces of convenient size for dipping, and after immersing the pieces, transfer them to the model and press into the forms desired.

The newspaper printing will show while
(Continued on page 134)

SUCH A MODEL AS THE ONE SHOWN MAKES A pleasing tree base. Besides adding motion to the scene, the railroad will stimulate fresh interest in the toy, and suggest the purchase of accessories in equipment for the boy's gift this year.

The tree-base model may be large or small, according to the space available. Indeed, the idea may be adapted on a generous scale to add novelty and distinction to a community Christmas tree or one prepared by a church or fraternal society



How the foundation is made of wallboard or fiberboard fastened together with adhesive tape

for the entertainment of the young folks.

That shown in the accompanying illustrations measured 5 ft. long and 4 ft. wide, which is about right to accommodate the circular track of the ordinary toy electric railroad.

A Bookcase Easy to Make

Requires Few Tools and Little Woodworking Knowledge

IF YOU have not had much experience in woodwork, you will find the bookcase illustrated one of the few really attractive and useful pieces of furniture that you can construct without a single difficult joint. The parts are put together with butt joints such as are used in making common boxes; there is not a dowel, a mortise and tenon, nor a dovetail anywhere.

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C Shelves, $\frac{3}{4}$ by 9 $\frac{1}{4}$ in. by 2 ft. 8 $\frac{3}{4}$ in.; 4 required

D Bottom of case, $\frac{3}{8}$ by 9 $\frac{1}{4}$ in. by 2 ft. 8 $\frac{3}{4}$ in.; 1 required

E Door stiles, outside, $\frac{3}{8}$ by 2 $\frac{1}{4}$ in. by 4 ft. 3 $\frac{1}{2}$ in.; 2 required

F Door stiles, center, $\frac{3}{8}$ by 2 9/16 in. by 4 ft. 3 $\frac{1}{2}$ in.; 2 required

G Door rails, $\frac{3}{8}$ by 2 $\frac{1}{4}$ by 11 $\frac{3}{4}$ in.; 4 required

H Door astragal, $\frac{3}{8}$ by $\frac{5}{8}$ in. by 4 ft. 3 $\frac{1}{2}$ in.; 1 required

I Rail at top of doors, $\frac{3}{8}$ by 3 in. by 2 ft. 8 $\frac{3}{4}$ in.; 1 required

J Rail at bottom of doors, $\frac{3}{8}$ by 3 $\frac{1}{4}$ in. by 2 ft. 8 $\frac{3}{4}$ in.; 1 required

K Back of case, $\frac{3}{8}$ in. by 2 ft. 8 $\frac{3}{4}$ in. by 4 ft. 10 $\frac{3}{4}$ in.; 5- or 3-ply stock; 1 required

L Back strips, $\frac{1}{2}$ by $\frac{1}{2}$ in. by 4 ft. 3 $\frac{1}{2}$ in.; 2 required

M Top filling, 1 $\frac{1}{4}$ by 1 $\frac{3}{4}$ in. by 2 ft. 8 $\frac{3}{4}$ in.; 2 required

N Baseboard, $\frac{3}{8}$ by 3 $\frac{3}{4}$ in. by 2 ft. 8 $\frac{3}{4}$ in.; 1 required

O Baseboard returns, $\frac{3}{8}$ by 3 $\frac{3}{4}$ by 10 $\frac{1}{4}$ in.; 2 required

P Top filling returns, $\frac{3}{8}$ by 3 by 9 $\frac{1}{4}$ in.; 2 required

Q Base filling returns, $\frac{3}{8}$ by 3 $\frac{5}{8}$ by 9 $\frac{1}{4}$ in.; 2 required

R Feet, front, $\frac{5}{8}$ by 4 by 4 in.; 2 required

S Feet, back, $\frac{5}{8}$ by 2 by 2 in.; 2 required

T Top back board, $\frac{3}{4}$ by 3 $\frac{1}{2}$ in. by 2 ft. 10 $\frac{3}{4}$ in.; 1 required

U Top back board overlays, outside, 1/16 by 1 $\frac{1}{2}$ by 10 in. veneer; 2 required

V Top back board, overlay, center, 1/16 by 2 $\frac{3}{4}$ by 11 $\frac{1}{4}$ in.; 1 required

W End overlays, 1/16 by 2 by 9 in.; 8 required

X Frieze overlays, outside, 1/16 by 2 $\frac{3}{4}$ by 5 $\frac{1}{2}$ in.; 2 required

Y Frieze overlay, center, 1/16 by 2 $\frac{3}{4}$ by 18 $\frac{1}{4}$ in.; 1 required

Z End overlays at top, 1/16 by 1 $\frac{1}{4}$ by 9 in.; 2 required

AA Door moldings (stock), 9/16 by 1 in. by 11 ft.; 2 required

BB Top back cleats, $\frac{1}{2}$ by $\frac{3}{4}$ by 5 in.; 2 required

CC Glass back molding, $\frac{1}{4}$ round, $\frac{3}{8}$ by $\frac{3}{8}$ by 11 ft.; 2 required

DD Hinges, butt or half surface, 2 by 2 $\frac{1}{2}$ in. brass; 6 required

EE Pushbutton catch, with or without lock, or other door catch or lock, brass; 1 required

FF Selected sheet glass, double thick, for doors

Either oak or whitewood may be used

(or other woods, if the builder desires). Even if the case is oak, the items C, D, J, M, P, and Q need only be whitewood.

The top of the case is held together by fastening the pieces M with screws or nails to the top, A, and the sides, B. Fastening the pieces P inside the ends at the top gives additional nailing places for the upper rail, I.

At the bottom the construction is
(Continued on page 150)

FREE—25¢ Book on Wood Finishing

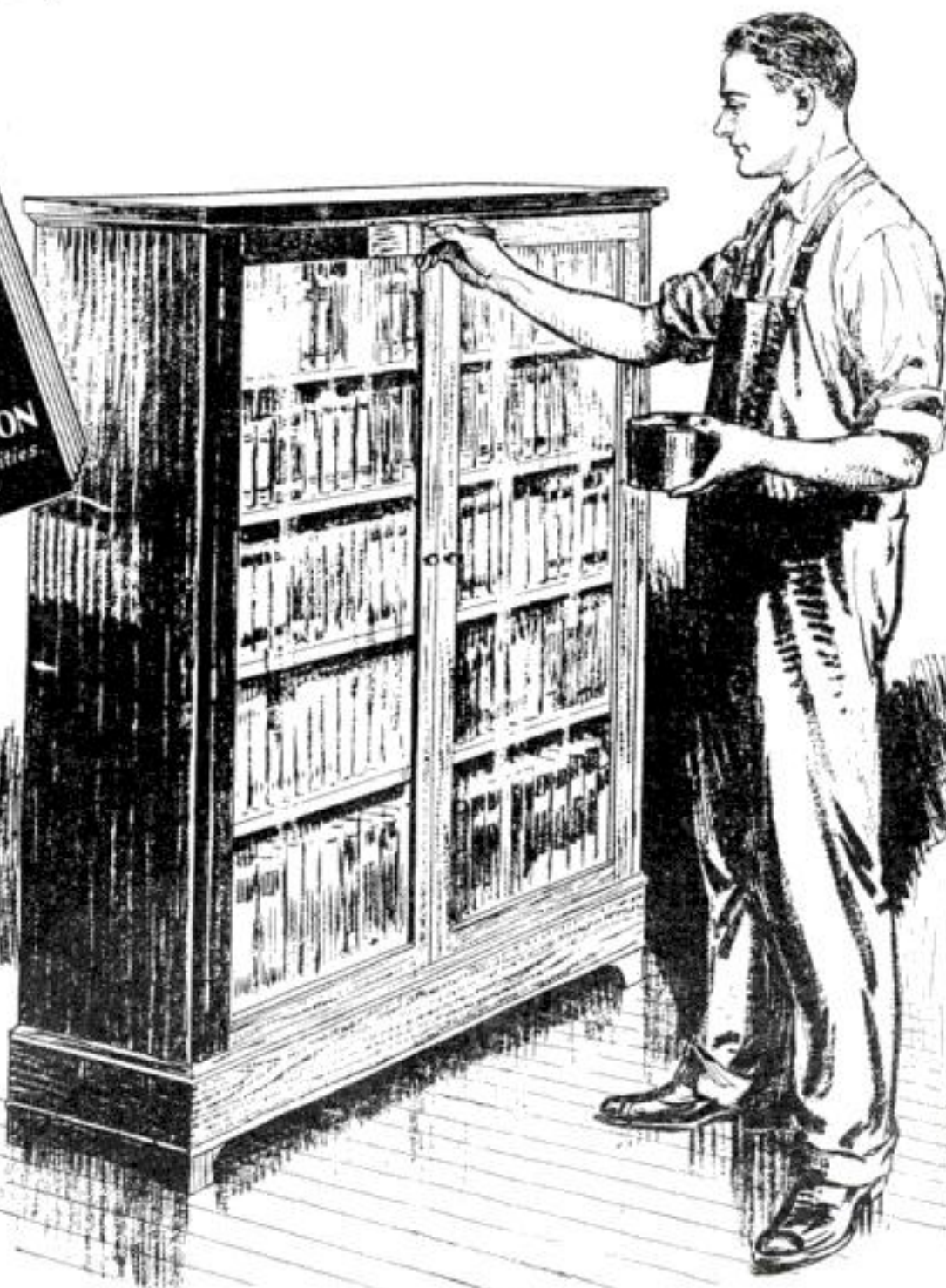


It Tells:

How to make your home more artistic, cheery and inviting.

How to keep floors, woodwork and furniture in perfect condition.

How to finish soft and hard woods.



It Tells:

How to stain wood artistically.

How to refinish old wood in stained and enameled effects.

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If you have a hobby for making cabinets, furniture, radio boxes, etc.,—you will find our Book invaluable. For, naturally, you want to give your handiwork a beautiful finish. Our Book gives complete instructions for finishing all wood—hard or soft, old or new. Tells how to make soft woods beautiful as hardwood. It is the work of experts—beautifully illustrated in color. Gives covering capacities—includes color charts, etc. Use coupon below.

JOHNSON'S WOOD DYE

(Penetrating)

Johnson's Wood Dye is very easy to apply. It dries in four hours and will not rub off or smudge—penetrates deeply, bringing out the beauty of the grain. Johnson's Wood Dye is made in 16 popular shades as follows:

No. 128 Light Mahogany	No. 125 Mission Oak
No. 129 Dark Mahogany	No. 130 Weathered Oak
No. 127 Brown Mahogany	No. 110 Bog Oak
No. 329 Red Mahogany	No. 172 Flemish Oak
No. 120 Fumed Oak	No. 178 Brown Flemish
No. 123 Dark Oak	No. 131 Walnut
No. 126 Light Oak	No. 140 Early English
No. 124 Golden Oak	No. 180 Gray
	No. 160 Brown Oak

All shades may be easily lightened, darkened or intermixed. Full directions on every label. Select the shade of Dye you want from the list above and order it from your dealer by name and number.

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"The Wood Finishing Authorities"

Johnson's Wood Dye is a *dye* in every sense of the word. It contains no finish whatsoever. Like most first class products it answers one purpose only—it dyes the wood—the finish must be applied over it. We recommend Johnson's Varnishes or Johnson's Polishing Wax.

Stores displaying the Johnson Service Department Sign carry a complete stock of Johnson's Artistic Wood Finishes and will be glad to show you finished wood panels—and answer questions on how to finish wood the proper way and give you a copy of the Johnson Book.

	S. C. JOHNSON & SON, Dept., P.S. 12, RACINE, WIS. "The Wood Finishing Authorities" (Canadian Factory—Brantford)
	Please send me free your Instruction Book on Home Beautifying and Wood Finishing. I enclose 10c to cover postage and wrapping.
	MY DEALER IS.....
	My Name.....
	Address City and State.....

How many radio miles did you go last night?

HOW many radio miles did you travel last night—that's the up-to-the-minute question. Did you voyage from New York to Chicago? Did you look in on Boston fifty seconds after, and on Philadelphia half-a-minute after that? If you *didn't*, why didn't you? There's fun and excitement, too, in a De Forest Radio—and it's ready to "get to work" five minutes after it enters your home.

Here is a Radiophone so astonishingly simple for the work it does that it's your best introduction to the marvels of radio space. Here is one so perfectly developed that it invites graduation from other less efficient instruments.

Here is a receiving set sponsored by the very genius who made radio, as we know it, possible—an instrument which offers a really remarkable demonstration in radio performance at a price far less than any instrument whose achievements compare with it. Here is a practical, a modern Radiophone, depending upon no out-strung wire to obtain results, but which, with a simple loop the size of a picture frame, opens to you a far-flung range of concert, speech and lecture—and all with a tonal purity, a sensitiveness of choice that is rare to any but De Forest users.



Ⓢ



DE FOREST RADIOPHONE

~ D-12 REFLEX ~



For Beauty and Clear Reproduction



Use the De Forest Loud Speaker. It reproduces naturally, brilliantly, without distortion. The adjustment of the reproducing unit assures uniform response over entire range of audible frequencies. Its horn is shaped to retain the full brilliancy of the original sound, and also to

add volume. The complete unit is free from rattles. No rattles can ever develop. Every De Forest Loud Speaker is thoroughly tested and is guaranteed free from defects.

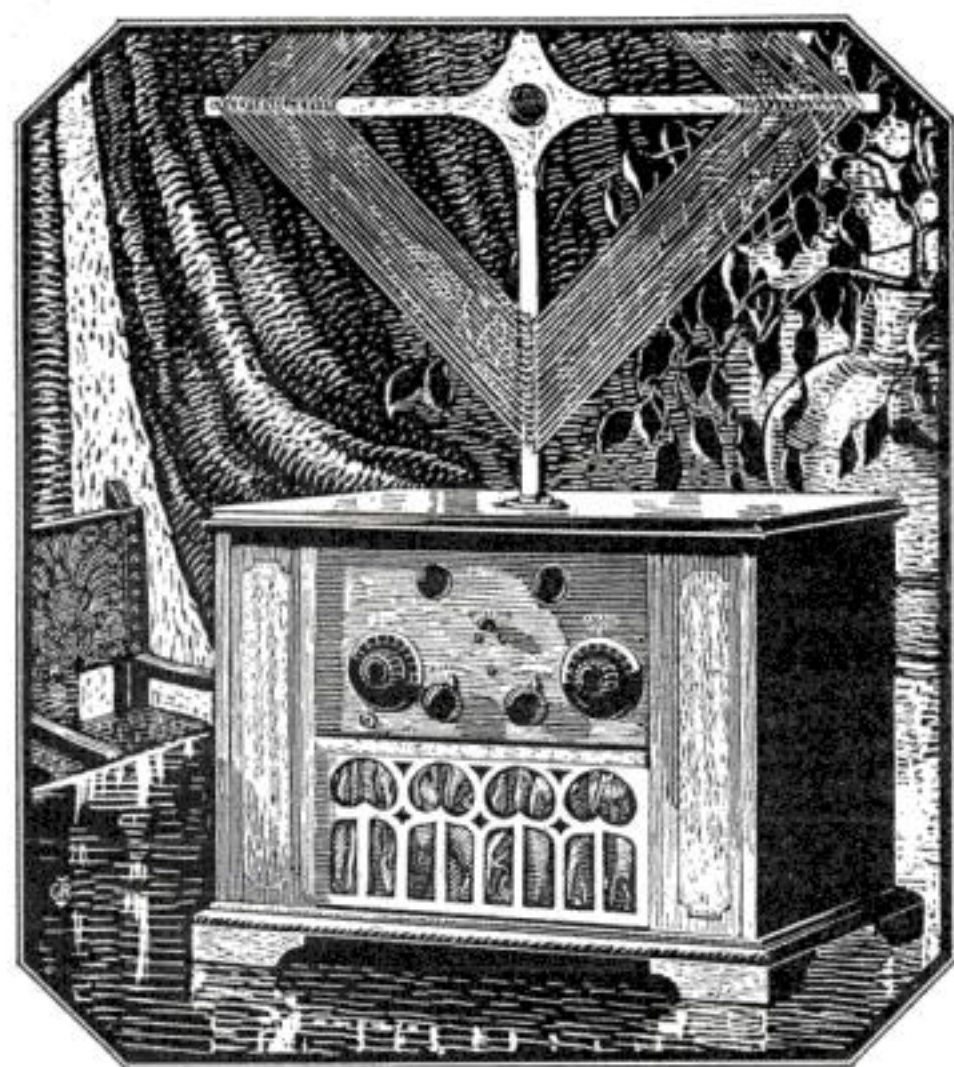
Sold by authorized De Forest dealers only. Price, with 6 feet of cord, \$25.00.

Ⓢ This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

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The De Forest Radiophone is a complete four-tube receiver, built on the best reflex principle. Its four tubes and crystal detector do the work of seven tubes with four-tube economy of operation.

We could be extremely technical in telling you how the four tubes do the work of seven and why the crystal detector gives both power and economy to this instrument. If you are technically inclined we shall be glad to do so if you will write us. Technical or not, however, know this: You can get splendid results from a De Forest D-12 Radiophone. Its upkeep is low. Its tone is clear and pure. It can be moved easily from room to room.



DE FOREST D-12 RADIOPHONE
Seven-tube efficiency with four-tube economy.
Ask the De Forest agent to demonstrate.

Why it pays to look for the De Forest agent

De Forest from first to last stands for all that is substantial and thorough and fundamentally right in radio. De Forest agents are qualified to give you sound and practical advice and help in radio. When you find a De Forest agent you find a man who knows radio—a man who has given us his word that he will see that every instrument he sells is thoroughly inspected and properly serviced after the sale. He has been carefully picked and schooled in the operation and care of De Forest Radiophones. He will install your instrument and explain to you simply how to get the fullest satisfaction and enjoyment from it.

Avail yourself fully of his help. You will find it valuable.

Prices on De Forest D-12 Radiophones

COMPLETE

Including loop, self-contained loud speaker, four De Forest tubes, A and B batteries, and all equipment ready to operate.

With Dry Batteries

In two-tone gray and black Fabrikoid cabinet	\$161.20
In two-tone Mahogany cabinet	176.20

With Storage Batteries

In two-tone gray and black Fabrikoid cabinet	180.00
In two-tone Mahogany cabinet	195.00

De Forest D-14 Radiophone

In burl walnut cabinet with loop and loud speaker built in. Price, including five DV-2 tubes, four B batteries, and storage batteries.	371.50
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DE FOREST RADIO COMPANY
Jersey City, N. J.

DE FOREST RADIOPHONE

D-12 REFLEX

Your Set Deserves De Forest Tubes

The original De Forest three-electrode vacuum tube was the first of many millions of De Forest tubes that have never been excelled in quality of workmanship, or performance. Today, as in the past, De Forest tubes are unsurpassed for giving volume and beauty of tone.

They are non-microphonic. They can be used with all standard circuits. The DV-3 is for use with dry batteries, the DV-2 with storage batteries. They are guaranteed against defects in material and workmanship. Sold only by authorized De Forest dealers. Price, \$4.00 each.

De Forest
DV-3 Tube
for use with
Dry Cell
Batteries



De Forest
DV-2 Tube
for use with
Storage
Batteries

Easily Made Furniture Delights the Kiddies

FOR the kiddies' Christmas a most useful and entertaining present is a table and set of chairs such as are illustrated. The material costs less than five dollars, yet this toy furniture is superior to store sets that cost from 15 to 25 dollars.

A careful study of the requirements was made before deciding upon the design, and the result is a set well proportioned for children between three and 12 years, strong and durable, light in weight, and attractive in appearance. The construction is simplified so that any one handy with tools can make it at home with a saw, a $\frac{1}{4}$ -in. chisel, a screw-driver, and sandpaper.

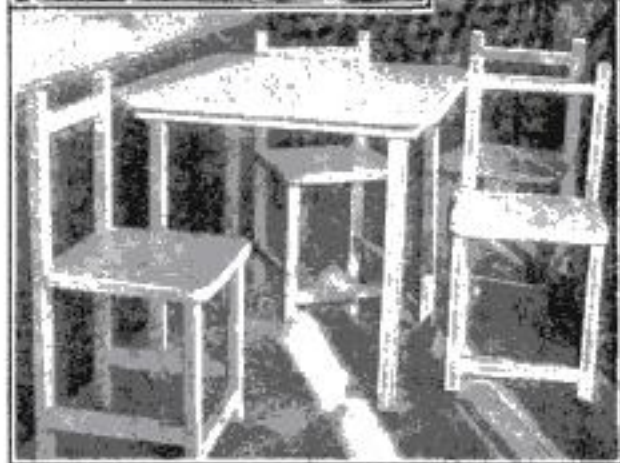
The pieces are made entirely of $\frac{1}{8}$ -in. wood, whitewood or poplar, oak, pine, cedar, or chestnut being satisfactory. All except the table top and seats is made from straight strips, $\frac{1}{8}$ by $1\frac{1}{4}$ in., which can be had from the lumber dealer, finished to the exact size.

The table top is made of two $\frac{1}{8}$ by 13 in. boards, 26 in. long. These boards are laid on the floor, and the edges coated with glue; then they are forced together and left until dry. Four 19-in. long strips of the $\frac{1}{8}$ by $1\frac{1}{4}$ in. stock are covered with glue on one edge and screwed to the under side of this top, forming a square frame. This braces the top and furnishes a support for the legs.

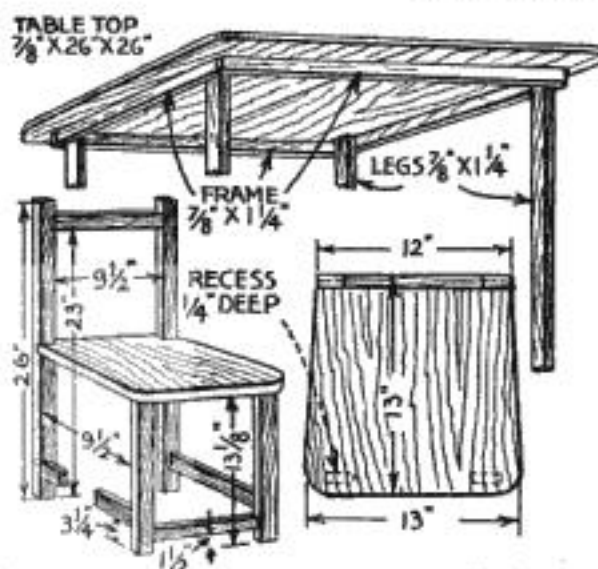
The legs also are $\frac{1}{8}$ by $1\frac{1}{4}$ by 19 in. They are glued and fastened by $2\frac{1}{4}$ -in. screws into each corner of the "box" or

By Homer S. Trecartin

Few tools are necessary for constructing this simple but attractive set of children's house furniture



Details of the table and chair are shown above. The completed set, composed of a table and four chairs, is illustrated at the left



long. Each back leg has a notch or groove for the seat cut with saw and chisel $\frac{1}{4}$ in. deep and $\frac{1}{8}$ in. wide. The bottom of this notch is $13\frac{1}{8}$ in. from the floor. The end of each stretcher is cut down on both sides so that it is $\frac{1}{4}$ in. in thickness for a distance of $\frac{1}{4}$ in. from the end, and grooves or mortises are cut with the chisel in the legs to fit these $\frac{1}{4}$ -in. tenons.

The seats are 12 in. wide at the back, 13 in. at the front, and 13 in. deep. A notch $\frac{3}{8}$ in. deep and $1\frac{1}{4}$ in. long is cut in each back corner to fit flush into the notch in the back legs. Depressions that are $\frac{1}{4}$ in. deep by $\frac{1}{8}$ by $1\frac{1}{4}$ in. are cut under the front corners of the seat 1 in. in from the front edge; these receive the tops of the front legs. The front corners of the seat and the top edges are well rounded.

In assembling the chairs the mortises are covered with good glue and forced together. Small angle-irons screwed on under the seat and to each leg add greatly to the strength.

When the glue is set, the articles should be rubbed very smooth with sandpaper—coarse, medium and very fine. Then a coat of paint thinned with turpentine is put on. When dry, this is lightly sandpapered. Next a coat of auto or furniture enamel (or better, two coats) give a beautiful and durable finish that will stand repeated washings.

An initial letter, or a simple design on each article, painted with enamel of some other color adds an individual touch that the children greatly appreciate.

"Catch 'Em Alive" Game Is Hilarious Sport

By Capt. E. Armitage McCann

THIS is a hilarious game designed as a Christmas novelty for the readers of POPULAR SCIENCE MONTHLY. It will afford endless amusement for two or more players—the more the merrier—yet it can be made with the simplest of tools at a cost of next to nothing.

It consists of a series of traps standing on a



Players with nets try to catch small objects shot into the air by concealed traps

table and hidden by cardboard or wooden scenery. The traps, released by one player, shoot butterflies, balls, birds, or other objects up in the air. The other players have to catch these in small butterfly nets.

Every object caught on its upward flight scores two; on the downward flight, one. The score can be varied, if desired, according to the rapidity of the flight. For example, a ping-pong ball will travel much more quickly than a butterfly or a bird.

To make the game, a board 18 in. or more in length and about 6 in. wide will be required. On the under side of this screw four or more strong mouse-traps of the flat type, obtainable for five cents each. At the point where the wire strikes when the trap is snapped, bore holes of such a size that a small ball, such as a ping-pong ball, will project slightly through them. Then, when the trap is snapped, it will shoot the ball into the air.

Fix this board on upright sides and a base, as shown on page 133. On the base, a little back from under the center of the traps, screw a long batten of such a length that the wire springs of the traps will just clear it. On this staple an elbow catch directly under each trap. Tie strings to each catch for releasing the traps. The base should be quite substantial and may be clamped to the edge of the table.

AT THE front of this mechanism erect a board or a piece of wallboard or fiberboard about 9 in. high and paint it
(Continued on page 133)

Merry-Go-Round Furnishes Fun for Skating Parties

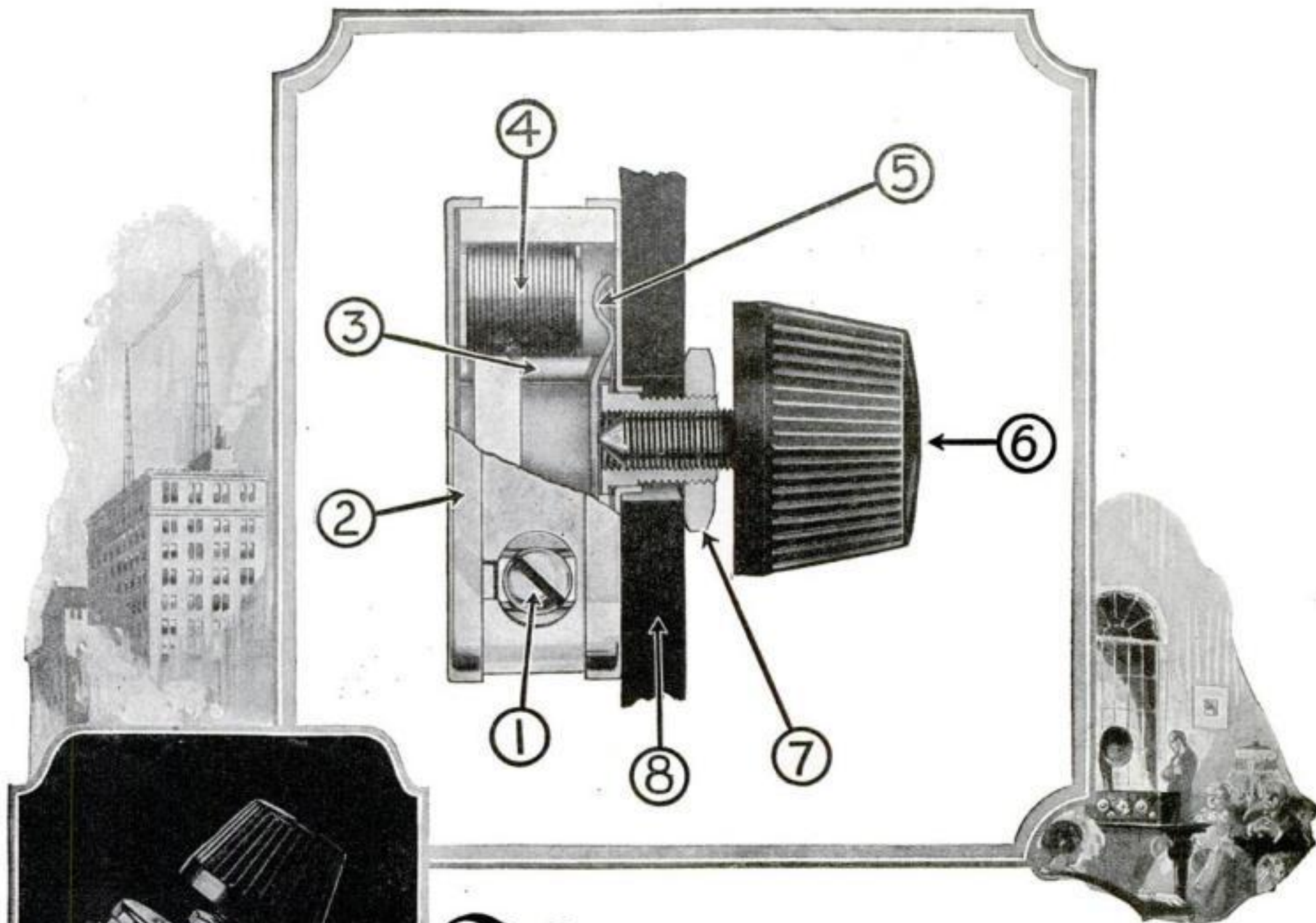
By Dale R. Van Horn

AN ICE merry-go-round will prove to be popular with any ice club or group of skaters. It may be made in two or three hours, if suitable materials are at hand. Select a stretch of ice some distance



This unique ice merry-go-round can be set up with very little work or expense

from shore where the water is only 2 or 3 ft. deep. Cut a hole through the ice and set a straight pole into the mud. Attach a wheel to the top by means of a bolt or lag-
(Continued on page 131)



Important Features

- 1 Two terminals suffice for ALL Tubes.
- 2 Back-panel extension is 11/16 inch.
- 3 Holes for table mounting are provided.
- 4 Graphite discs give stepless, noiseless control.
- 5 Internal switch opens battery circuit.
- 6 One knob provides control from 1/4 to 100 ohms.
- 7 One locknut holds Bradleystat securely in position.
- 8 Drill only one hole in panel.



The New Bradleystat

Supreme in design and performance

ASIDE from the novel "one-hole mounting" that characterizes the Allen-Bradley line of radio devices, the most striking new feature is the extreme compactness of the graphite disc container. When mounted on panel, the new Bradleystat extends less than three-quarters of an inch behind the panel. The same is true of the Bradleyleak and the Bradleyohm. And the Bradleyometer extends only seven-eighths of an inch. You can improve your radio set immensely by substituting a Bradleystat for your present wire rheostat or a Bradleyleak for your old grid leak. There's plenty of room. Try it!

Allen-Bradley Co.

Electric Controlling Apparatus
293 Greenfield Ave. Milwaukee, Wis.

Baltimore
Birmingham
Boston

Buffalo
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Philadelphia
Pittsburgh
Saint Louis

Saint Paul
San Francisco
Seattle

Better Shop Methods

How Expert Mechanics Save Time and Labor



Old Bill Repairs an Engine

By James Ellis

Machine-Shop Superintendent

IT SEEMED that everything was wrong that morning. The big boss had promised certain delivery on a rush job, and now a huge casting that was an important part of it was missing! In fact, there were two castings. One was in the machine-shop, but the other was still pig iron.

Old Bill always had enough to do to keep the machine-shop running smoothly without bothering about the foundry, but this time he hied himself out to see what the matter was.

"Couldn't melt enough iron to make both castings the same day," the foundry foreman explained.

Old Bill reminded him that he had made two like that before; indeed, had made three.

"Well, the old cupola won't melt like it used to," said the foundryman. "It's been getting worse all the time. I don't believe that we have as much draft as we ought to have."

Old Bill did not like explanations; what he wanted were results. He went out to the foundry again that afternoon and looked around. He saw what was wrong. The fan was not running up to speed, and of course it was not giving the proper blast. He went over to the engine, and a trained ear told him what the trouble was.

"Have to fix up that old gal," he mused, and went to tell the foundry foreman what he was going to do.

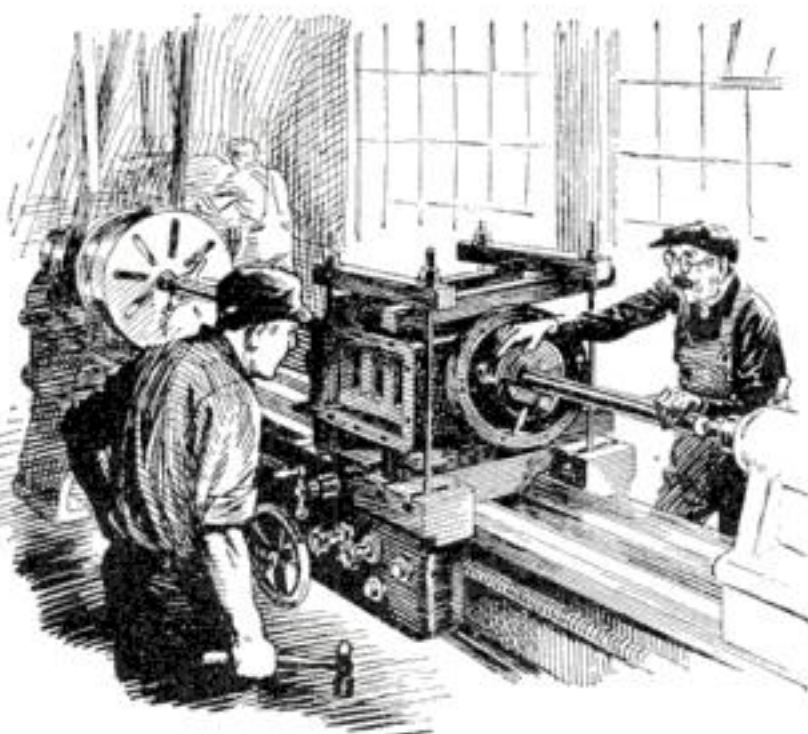
First thing the next morning two of Old Bill's boys were taking the engine to pieces. It was not a large one, about 8 by 11. He watched to be sure that enough marks were put on to make certain everything would go back properly.

As soon as the piston came out, Old Bill gave a grunt.

"It's a shame the way these iron melters treat machinery,"

he burst out. "They don't know how to take care of anything! I wonder if they know there is such a thing as oil?"

It did look bad. The rod was scored and cut, and one of the rings was broken.



Old Bill explains the trick of boring an engine cylinder accurately and shows how to clamp the casting to a shaper

Bill looked into the cylinder, passed his hand in, and felt a groove, so he gave orders for the cylinder to be taken off too. He sent the piston to the shop to have a new one made while he was still taking off the cylinder.

"Be sure and leave enough so that we can fit it after the cylinder is rebored," he cautioned. "Jack, you take the cylinder in to that 24-in. lathe by the door and bore it, and don't lose any time, for we shall have to face the valve seat before we put it back."

He looked at the brasses, and sent them in to another machinist. He was satisfied

with the crankshaft and with the guides, but decided to true up the valve stem.

He had started to the machine-shop and was about halfway there when he met Jack coming for him.

"This cylinder won't swing in the 24-inch lathe," said Jack. "I shall have to wait until I can get the 30-inch machine."

Old Bill laughed a little.

"I don't want you to swing it, sonny," he said. "We can do a better job if we don't swing it at all!"

Jack seemed to be perplexed, but he followed Old Bill toward the lathe.

"Pick up some of those bars there; we may need them," Old Bill said, as they passed a box where long bolts, clamps, and various kinds of blocks were kept.

"Now then, run the cross-slide off the back, for we want to get that out of the way," Old Bill said. "Get the cylinder up on the carriage and I'll be back."

It was some minutes before he returned, and the cylinder casting was lying on the carriage just about where he wanted it. He was carrying a

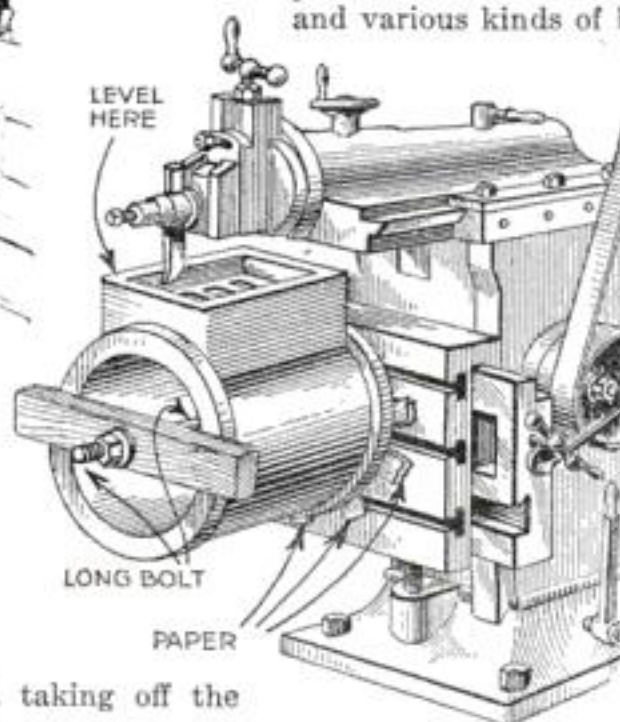
piece of shafting about 3 in. in diameter and 4 ft. long. A helper was following with what appeared to be an old shaft coupling.

Old Bill put his piece of shafting through the hole in the cylinder and swung it on the centers. He took his rule out and measured the distance from the top of the bar to the top of the cylinder bore, and from the bottom of the bar to the bottom of the bore. He did a little mental arithmetic.

"Now raise the casting about 2½ inches," he said.

By this time the boys had a pretty clear idea of what he wanted to do, so it was no time before the cylinder was raised the required amount, the coupling casting mounted on the bar, and the bar put back between the centers. The coupling had a slot to fit a toolbit, and a clamp to hold it in place. A tool was put in this slot and swung around one end of the cylinder. The

(Continued on page 110)



Old Bill Says—

WHEN you have finished with a machine, clean it up and leave it in a presentable condition. Let's hope the next man who uses it will do the same.

Accidents are always unexpected. Be careful.

If a machinist knows what he is doing, you can tell it by the way he tackles a job.

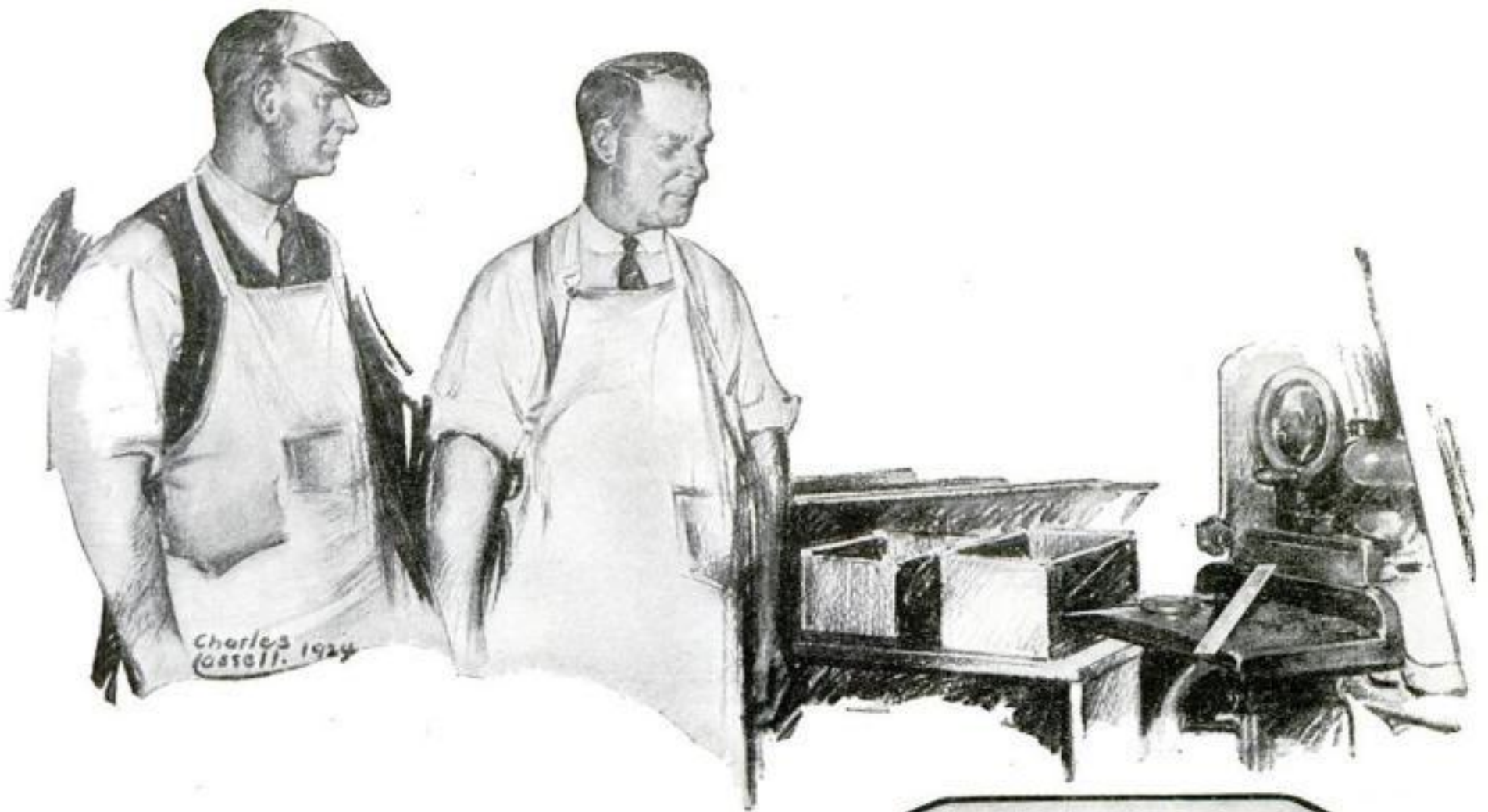
Without patience no mechanic can hope to get very far; it's one virtue he must have.

It's less embarrassing to ask questions than to spoil a job.

Suppose you were asked to inspect and pass on your own work—what kind of an inspection ticket could you make out?

The cutting speed for any kind of metal-cutting tool is limited only by the ability of the tool to resist the heat, strain, and pressure of the cut without burning or breaking.

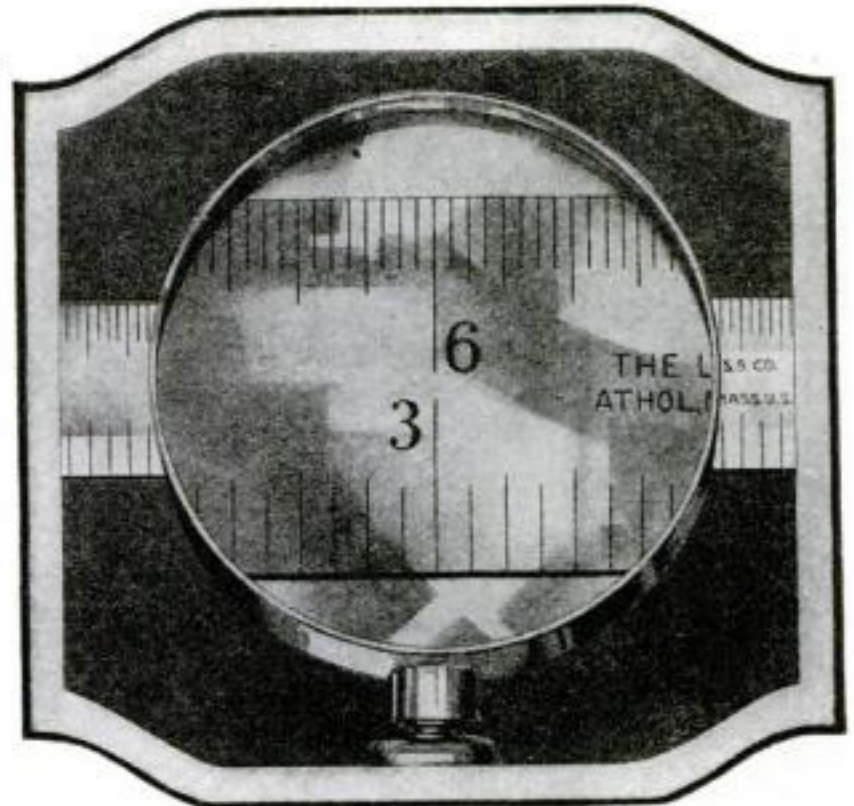




"BILL'S got another new rule, I see. He sure does rust 'em out."

"Not any more—that rule is the same one he's been using for the last two years. It always looks like that—it's a Starrett Stainless."

RUST PROOF



Starrett Stainless Steel Rules laugh at moisture, perspiration and certain acid fumes that soon destroy the usefulness of the ordinary rule. They are made from a fine quality non-rusting, non-staining steel. No. 1000 (hardened and tempered) is made in 6 and 12 inch lengths. No. 1020 (flexible) supplied in 6 inch length only. Like all Starrett Rules, the Stainless is graduated with extreme accuracy—a reading glass proves that even when magnified the division lines show up sharp and clean-cut—perfect in every way. Use Starrett Rules for closer and easier work.

THE L. S. STARRETT CO.

World's Greatest Toolmakers—Manufacturers of Hacksaws Unexcelled
ATHOL, MASS.

FREE REFERENCE TABLES

Wire Gauge Standards, Decimal Equivalents, Allowances for Fits, Tap Drill Sizes, Color Chart for use in Tempering, Lubricants for Cutting Tools, Drill Speeds, Double Depth of Threads, Metric Conversion Tables Miscellaneous Measurements, Tables for Computing Weight of Cast Steel.

All this and other valuable information needed by every tool-user will be found in the back of the NEW STARRETT CATALOG. Mailed FREE. Write for No. 23 W



Starrett Tools

7213

Ⓢ This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

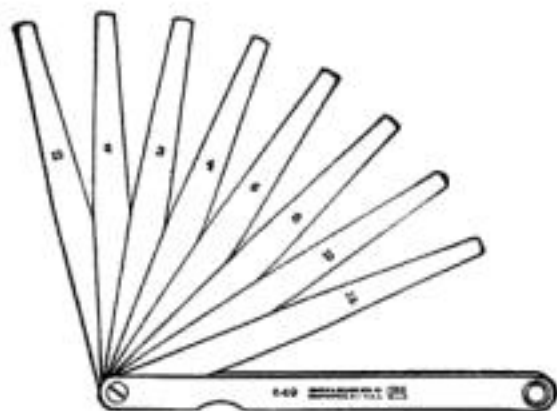
HERE'S WHY—

I Added These
NEW
BROWN & SHARPE
TOOLS
To My Kit



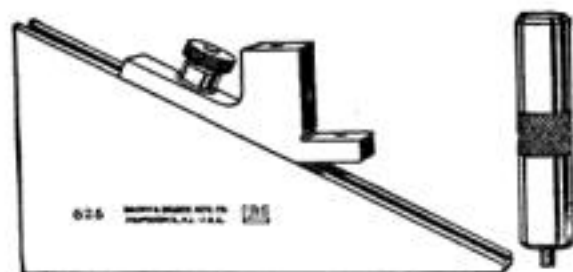
No. 577—Thread Tool Gauge

"The Brown & Sharpe Thread Tool Gauge is adjustable and checks any thread cutting tool from a sharp V to a one inch flat within a given angle. It eliminates my keeping a variety of slot gauges on hand for all the different pitches."



No. 649—Thickness Gauge

"I needed a thickness gauge with long blades and one that I knew was accurate, so I chose a Brown and Sharpe Thickness Gauge No. 649 because the 6-in. blades are accurately ground to size."



No. 625—Planer and Shaper Gauge

"My Brown & Sharpe Planer and Shaper Gauge No. 625, saves me much time. It is quickly set with a Micrometer, Vernier or Caliper and then the planer cutting tool is accurately set to the gauge."

Learn more about these and other new and useful Brown & Sharpe Tools by sending for a copy of the No. 29 Small Tool Catalog, which is yours for the asking. Write for a copy today.

BROWN & SHARPE MFG. CO.
Providence, R. I., U. S. A.

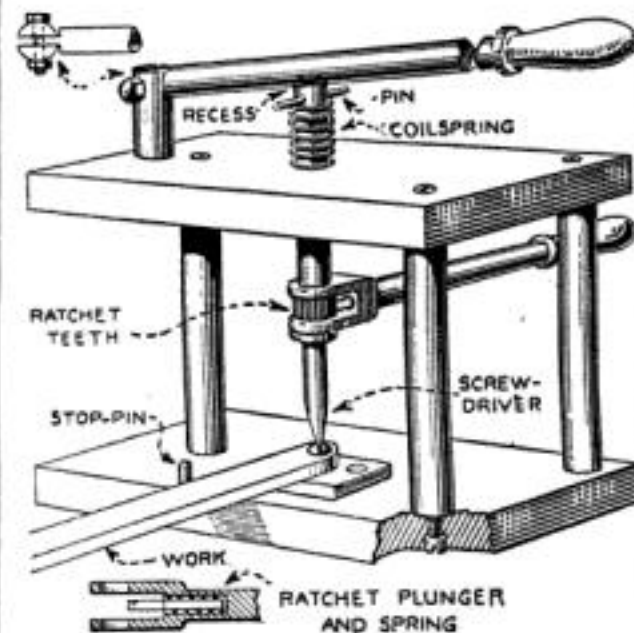
BROWN & SHARPE TOOLS

"Standard of the Mechanical World"

Ratchet Fixture for Driving Machine Screws Tightly

THE work of assembling the parts of small machines and other mechanisms in large quantities, when many small screws must be handled, can be speeded up by the use of special fixtures for driving the screws in place. Usually a simple fixture for this class of work can be made at small cost, yet it may cut in half the time required by hand methods.

The construction of a screw-driving fixture I have been using on a difficult job is



The screwdriver bit is held down with one lever and turned with the other

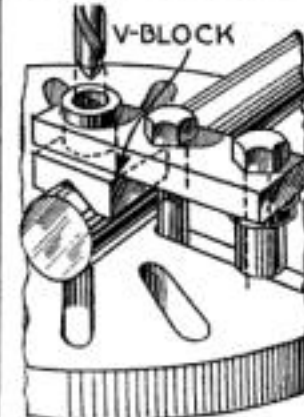
shown clearly in the accompanying illustration. Pieces to be assembled are placed on the base plate with the screw inserted in its hole and the screw is brought in line with the screwdriver bit.

Bearing down on the upper handle holds the bit solidly in the screw slot. The screw then is driven rapidly home with the ratchet handle. When the upper handle is released, the coil spring at the top raises the spindle in position for the next screw.—F. J. W.

Quick-Acting Jig for Drilling Holes in Round Stock

DRILLING transverse holes through round-bar stock or pipe usually necessitates setting up a V-block on the table of the drill and some form of top plate with a guide bushing.

One of the simplest ways of handling such work is with a combined block and jig, as illustrated.



One turn releases the clamping piece

A clamping piece is made and drilled to accommodate the special V-block. Various sizes of drill guide bushings thus can be used in the one holder. A spacing support of pipe goes over the end bolt.

With the stock on the drill table and the guide block in position, tighten the inside bolt to clamp the work. To change parts, one turn of the inside bolt releases the clamp and jig. Much time can be saved with this fixture on repetition work.—G. L.



Better than "Home Made"



TEN, fifteen, or twenty years ago, home-canned fruits were better than those bought at the grocers. But today, the products of the canners are *uniformly* better than foods canned at home.

It isn't by chance that today you can buy canned fruits, vegetables, meats and fish that you know—even before you open the can—will be delicious.

There is a distinct reason why there has been a big improvement in the quality of all canned goods. It is the *exact control of heating processes*. *Tycos* Temperature Controlling, Recording and Regulating Instruments—the Sixth Sense of Industry—makes possible the production on a large scale of cooked products of an absolutely uniform quality.

By using *Tycos* Thermometers in cooking, women in the home can now get the same uniform results that the big canners get.

Whether you are in the business of canning fruits, vegetables, meats, or other cooked products, or interested only in cooking in the home, there are *Tycos* Temperature Controlling, Recording and Regulating Instruments made to be of specific help to you.

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If your manufacturing problems require the indicating, recording, or controlling of heat, whether you manufacture steel, or pack sardines, there is a type and style of instrument in the *Tycos* Line of 8000 varieties that you need.

Informative literature on any type of instrument will be sent you promptly on request. Or our engineer will consult with you on the application of *Tycos* to your manufacturing process.

Canadian Plant
Tycos BUILDING
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Taylor Instrument Companies
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Tycos— for the Home

Tycos Office Thermometers
An aid in promoting human efficiency.

Tycos Bath Thermometers
To enable you to get the most good from your bath.

Tycos Home Set
Bake Oven Thermometer, Candy Thermometer, Sugar Meter. The secret of accurate results in cooking.

Tycos Wall Thermometers
To help you maintain a temperature in your house conducive to good health.

Tycos Quality Compasses
To show you the right way in unfamiliar country.

Tycos Fever Thermometers
A necessity in every home.

Tycos Stormoguide
Forecasts the weather twenty-four hours ahead with dependable accuracy.

Tycos Hygrometer
To enable you to keep the humidity of the atmosphere in your home correct at all times.

Your dealer will show them to you. Ask us on a postal, for booklets on any of the above.

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Tycos Temperature Instruments
INDICATING • RECORDING • CONTROLLING



HOMCHARGER and Christmas



*Give the Gift
of Distance
and Volume*

YOU can give the most welcome gift of radio—increased distance and volume. This is the gift to be used and cherished for years to come.

The New Silent GOLD SEAL HOMCHARGER

Anyone who can operate a radio set can use the new silent GOLD SEAL HOMCHARGER.

More than 200,000 satisfied users of the HOMCHARGER are doing this to-day. Give your family, your friends, everybody, the gift of better radio, resulting from the great advantages of storage battery tubes.

So "Christmassy"! Finished in handsome bright mahogany-red and gold, the new silent GOLD SEAL HOMCHARGER makes a happy, brilliant display de luxe. It has rubber feet, too, and can't mar polished tables or floors.

FREE! Get the interesting booklet, "The Secret of Distance and Volume in Radio," containing valuable information on radio at its best, and fully describing the new silent GOLD SEAL HOMCHARGER. Your dealer has it; if not, send us his name and we will mail you a copy post-paid.

THE AUTOMATIC ELECTRICAL DEVICES COMPANY

Largest Manufacturers of Vibrating Rectifiers in the World

131 West Third Street, Cincinnati, Ohio

Under the same management as the Kodel Manufacturing Company

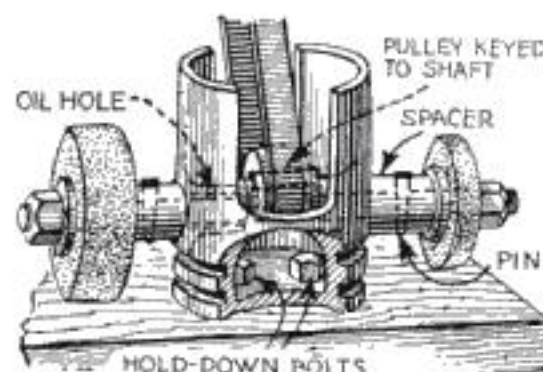
14 GOLD SEAL HOMCHARGER features

- 1—Simple; needs no care.
- 2—Efficient; costs about 5c to charge the average battery, much less than bulb or liquid types of charger.
- 3—Quick; brings battery up to full charge overnight.
- 4—Tapers charge; cannot injure the battery.
- 5—Clean; no bulbs to break, no liquids to spill or produce fumes.
- 6—Dependable; adjusted and sealed at factory.
- 7—Lasts forever; only one moving part, the Tungsten contact, which can be replaced at \$1 after many thousands of hours of use.
- 8—Fool-proof; charges automatically, no matter which clip is attached to which battery terminal.
- 9—Safe; approved by Fire Insurance Underwriters. No shock or fire.
- 10—Beautiful, sturdy metal case finished in mahogany-red and gold.
- 11—Universal; made in types for all voltages of alternating and direct current. Charges all radio "A" and "B" batteries, and automobile batteries.
- 12—Quiet; its faint hum cannot be heard in next room.
- 13—Unqualifiedly guaranteed.
- 14—Popular price; sold everywhere for \$18.50; in Canada \$26. Complete, no extras to buy.

Piston Used as Stand for Small Bench Grinder

A FIRST class belt-driven grinding stand can be made from a discarded piston. Obtain a piston with fairly good bronze wristpin bearings and saw away a portion of the piston skirt, as shown, so that the belt will have no interference.

From a piece of cold rolled steel or an old axle, turn the wheel shaft to fit the bearings and thread at each end. If the bearings are not a standard size, it will be necessary to turn the shaft at the section where the wheels will be mounted to one



The bronze wristpin bearings of a discarded piston support the grinder spindle

of the standard wheel fit sizes, which generally run in even eighths up to an inch.

Spacers are used on each side of the piston to hold the wheels the proper distance away and also on each side of the pulley. The pulley may be any convenient diameter and should be keyed or otherwise fastened to the shaft. Oil holes should be drilled and the piston bolted to the bench before the shaft is assembled.

It is advisable to pin the two outside spacers to the shaft with taper pins so that when the wheel nuts are drawn up there will be no undue binding.—W. F. SANDMANN, Indianapolis, Ind.

Lubricating the Cutter on a Vertical Milling Machine

VERTICAL milling machines not always are equipped with an oil tank. To supply oil to the cutter in such a case, I have used the method shown with success and pass it along to others who still may be using a squirt can or brush.

An ordinary soap can, fitted with a wire bail, is hung from any convenient location or projection above the cutter. A piece of soft brass or copper wire of suitable length is doubled back on itself and twisted loosely. One end is wrapped with a piece of cotton waste and bent to hang over the rim of the can, nearly touching the bottom. The other end is left forked and bent around the shank of the cutter to allow the wire to ride off the shoulder. The can is filled with oil and the waste is well soaked. In a very few minutes the oil will start to flow and keep the mill well supplied.—H. W.



For millers without an oil tank



THIS BATTERY WILL
MATERIALLY REDUCE
YOUR OPERATING
COSTS ON HEAVY
CURRENT SETS

NEW!

Eveready Heavy Duty "B" Battery. 45 volts. Three Fahnestock clips. Length, 8 $\frac{3}{16}$ inches; width, 4 $\frac{7}{16}$ inches; height, 7 $\frac{3}{16}$ inches; weight, 13 $\frac{3}{4}$ pounds.

Price \$4.75

Stands up to heavy duty

THE new Eveready 45-volt heavy duty "B" Battery (No. 770) is made to stand up and deliver the large plate current required by multi-tube receiving sets. Extra large powerful cells, packed with the famous Eveready vim and vigor, give longer life on severe service. For "B" Battery economy use the Eveready 45-volt "B" Battery No. 770 on receiving sets using four or more tubes and operating at 90 volts or more, and all power amplifiers. There is an Eveready Radio Battery for every radio use. Buy them from your dealer.

Manufactured and guaranteed by
NATIONAL CARBON COMPANY, INC.
Headquarters for Radio Battery Information
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No. 772
Vertical 45-volt, large
size "B" Battery
Price \$3.75



No. 764
Vertical 22 $\frac{1}{2}$ -volt
"B" Battery
Price \$1.75

No. 7111
Eveready Radio
"A" Dry Cell
Specially
manufactured for
use with dry cell
tubes
Price 40 cents



No. 766
Eveready "B"
22 $\frac{1}{2}$ volts. Six
Fahnestock spring
clip connectors
Price \$2.00



EVEREADY

Radio Batteries

—they last longer



Bench Milling Machine
No. **644**
Price \$120.

Make yourself a present of this milling machine

JUST the thing that every amateur mechanic and owner of a small workshop longs for.

Has a three-step cone pulley, $1\frac{1}{2}$, $2\frac{1}{2}$, and $3\frac{1}{2}$ inches in diameter, for 1-inch driving belt. Live spindle has cone bearing to take up wear.

The table measures $11\frac{1}{2} \times 3\frac{3}{8}$ inches and can be fed three ways by hand wheels. Feed screws have graduations for fine adjustment. Knee is elevated by a screw operated by a hand wheel at back of frame. Bench space of pan or bed, 8 x 12 inches.

This machine is furnished complete with a compression chuck with $\frac{3}{8}$ -inch bushing. Countershaft, arbor, vise or centers may be purchased separately.

Other tools for amateur mechanics

The Goodell-Pratt Catalog No. 15 is a genuine paradise for tool-lovers. In it are shown all the 1500 famous good tools—many of special interest to the man who is building up his own workshop and who is on the lookout for more complete equipment. Catalog No. 15 is free. Write for a copy.

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GREENFIELD, MASS., U. S. A.

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Toolsmiths

Makers of Mr. Punch

GOODELL-PRATT
1500 GOOD TOOLS

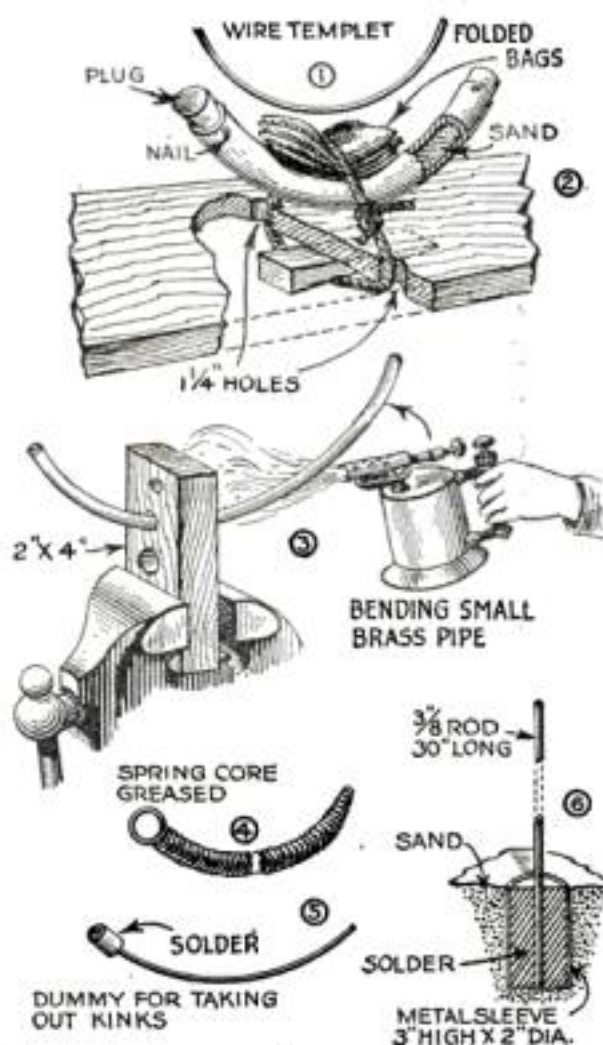
Methods that Aid in Bending Pipe Successfully

By C. F. Waldron

PLUMBERS, pipe-fitters, and electricians frequently are called upon to install a pipe job requiring many bends. To make them neatly, accurately, and quickly is a real test of mechanical skill, especially without a pipe-bending machine or special tools.

The bending of pipe, indeed, should be practised among plumbers and fitters more than it is. The use of bends in place of fittings where possible results in work of neater appearance, a saving in fittings and better results. This is especially true in the case of hot-water installations or where circulation is required, on pump suction to eliminate friction, and on waste lines to lessen the danger of stoppages. Pipe is always weakest at the threaded joints.

Lead pipe from $\frac{3}{8}$ to $\frac{1}{4}$ in. may be bent over the knee, and larger diameters also



Bending lead pipe to wire templet, bending pipe tubing, and method of making cores and dummies

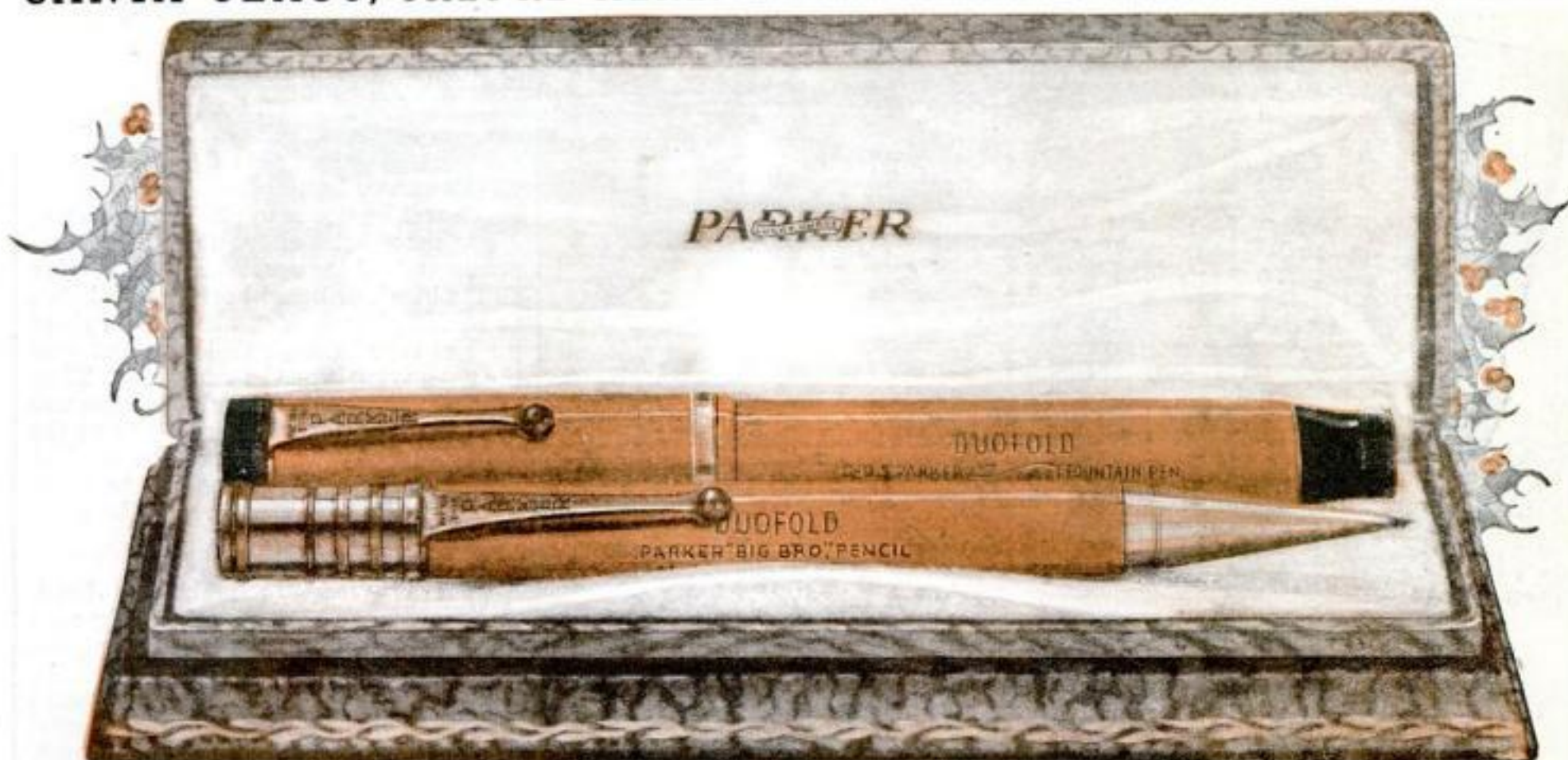
may be bent this way if the bend is not too short. For short bends a spring, well greased, is sometimes used (Fig. 4), although filling the pipe with sand and plugging the ends will give better results. It is important to have the sand dry and well packed in the pipe. Plug the ends with wooden plugs. When filling the pipe with sand, tap the outside occasionally with a piece of soft wood or a wooden mallet to shake the sand down.

In making bends over the knee on pipe 1 in. and larger, a bag or piece of heavy cloth should be used as a pad to prevent kinking.

If the required bend is difficult to measure, make a wire templet, bending it to the radius wanted as shown in Fig. 1. Before making the bend, always dress the sides

(Continued on page 106)

SANTA CLAUS, THEY'RE HERE! THEIR FIRST CHRISTMAS TOGETHER



Over-size Duofold Pen \$7 • New "Big Bro." Duofold Pencil to Match \$4—or Standard Size Duofold Pencil \$3.50

34 "Inquiring Reporters"

Settled the Gift Question for You

*When they found more people
wanted the Parker Pens than any other make*

**Yes, and a Parker Duofold with 25-year point will make
this a 25-year Christmas for those to whom you give it**

WHAT they told the "Inquiring Reporters" from 34 newspapers is the answer you would get if you asked your friends and loved ones to name their Christmas gift.

Out of 2024 people picked at random more named the "Parker" Pen than any other make when the reporters asked: "What pen will you buy next?"

And there's no finer gesture of affection than to send these reigning favorites instead of trifles that have no permanent value.

To the man give the \$7 Over-size Duofold with the man-size grip, and the extra ink-supply that is just like money in the bank when needed.

To the woman or girl give slender Lady Duofold, \$5. To the boy give Duofold Jr., \$5.

Duofold pencil to match any one of the pens, \$3.50. New "Big Bro." Duofold Pencil, \$4, a real

mate for the Over-size Duofold Pen in build and finish. The first mechanical pencil with a balanced over-size grip that doesn't cramp or tire, but makes a friend of the hand the instant you grasp it.

Satin-lined Gift Box De Luxe included with Duofold Pen and Pencil sets, called Parker Duofold Duettes.

All Parker Duofold Pens are made in flashing plain black, as well as lacquer-red, black-tipped. All have the jewel-smooth Duofold point that's guaranteed, if not abused, for 25 years' wear. All have the same hand-fitting symmetry and balance that inspire writing, and give one's penmanship the speed and character that win with the world.

But don't be late in ordering from the first pen counter—else there may not be time to have your Duofolds engraved with the names of the lucky ones who're to get them.

THE PARKER PEN COMPANY • JANESVILLE, WISCONSIN
NEW YORK • CHICAGO • SAN FRANCISCO • SPOKANE • LONDON, ENG.
THE PARKER FOUNTAIN PEN COMPANY, LTD., TORONTO, CANADA

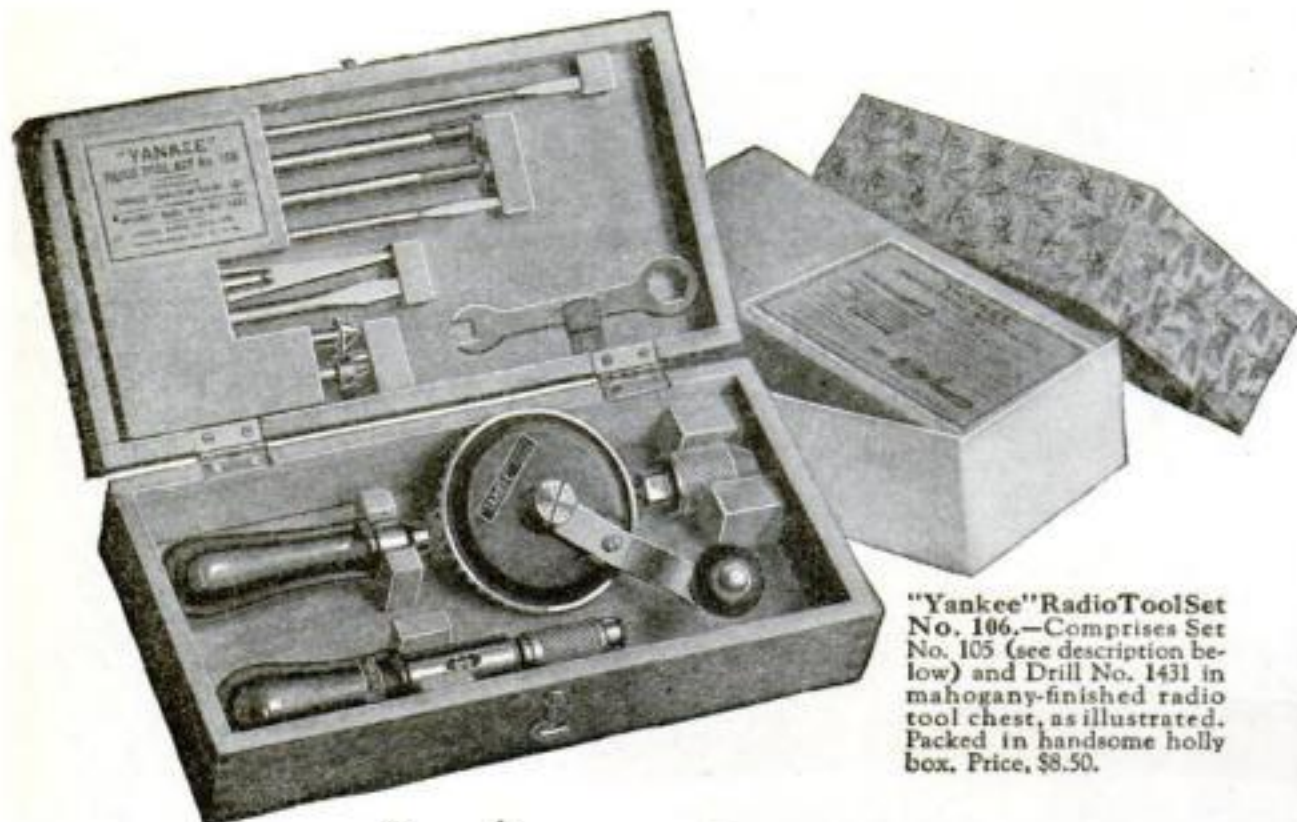
Red and
Black Color
Combination
Reg. Trade
Mark U. S.
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Duofold Jr.
\$5

Parker
LUCKY CURVE
Duofold
With The **25 Year Point**



Lady Duofold
\$5
Ribbon \$1 extra



"Yankee" Radio Tool Set No. 106.—Comprises Set No. 105 (see description below) and Drill No. 1431 in mahogany-finished radio tool chest, as illustrated. Packed in handsome holly box. Price, \$8.50.

The Ideal Christmas Gift for the Radio Fan

"YANKEE" Radio Tools

WHAT interests men the most about radio? Tinkering, of course! Building new sets; changing hook-ups on old ones; experimenting for better results—that's what men and boys enjoy.

So the gift of "Yankee" Radio Tools is sure to be appreciated.

"YANKEE" Radio Tool Set No. 105. Price, \$3.25

Set No. 105 comprises "Yankee" Ratchet Tool Holder (a) with "Yankee" Radio Attachments as follows:

Long Screw-driver Blade (h)—for reaching into box, between wires, etc.
Small Screw-driver Blade (c)—for screws on dials, etc.
Heavy Screw-driver Blade (g)—for putting up aerials, etc.
Countersink (f)—for sinking heads of screws.
Reamer (b)—for enlarging holes in panel.
Wire Bender (j)—for making loops and turns.
Socket Wrenches, two sizes (d e)—to cover all small nuts.
Also, Flat Wrench, (i)—for square or hex, one end; other end, hex for jacks.
Packed in holly box.

"YANKEE" Radio Drill No. 1431. Price, \$3.00

No. 1431 is a compact, powerful, perfectly balanced hand drill with four to one gear for speed and special radio chuck. Capacity 9/32 inch.

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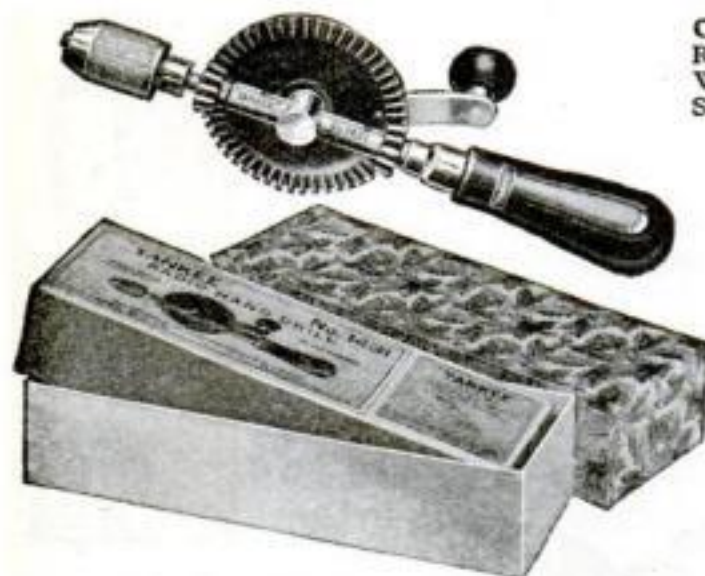
Your hardware dealer can supply "YANKEE" Radio Tools

Write for Free "YANKEE" Tool Book

NORTH BROS. MFG. CO., Philadelphia, U. S. A.



Set No. 105. Price, \$3.25
Comprises "Yankee" Ratchet Tool Holder and all "Yankee" attachments for radio work, as described. Packed in gift box.



"Yankee" Radio Drill No. 1431
Price, \$3.00. Packed in gift box.

"YANKEE" TOOLS

Make Better Mechanics

Tricks in Bending Pipe

(Continued from page 104)

in slightly with a smooth board, as the pipe, even when filled, has a tendency to swell at the sides.

For bending lead pipe from 2 in. up in diameter, two holes bored in a plank or bench will be necessary to hold the pipe. Make these holes about 1 1/4 in. and approximately 7 in. apart. Place the pipe on the bench or board between the holes, as indicated in Fig. 2, and pass a short piece of rope through the holes and over the pipe, tying it on the under side. Then place a bag or pad between the rope and the pipe to prevent kinking. By using the wire templet, the pipe can be marked with chalk where the bend is to start. Roll the wire and mark where the other end terminates.

WHEN ready to make the bend, place the bag underneath the rope and tie it firmly. Always lift the pipe—never push down. If the bend is to be short, a wedge may be driven underneath the bench or plank to tighten the rope. Do not try to make the bend in one pull, especially if it is a short one. It is sometimes necessary to reheat several times, trying the templet in each instance and marking where heat is needed.

If the pipe swells at any point, it can be dressed in after the sand has been removed and the inside kinks can be dressed out with a "dummy." A good dummy (Fig. 5) can be made from a piece of 3/8-in. steel wire about 30 in. long, and an iron sleeve about 2 in. in diameter by 3 in. high. Set the wire upright in the sleeve, pack sand around the sleeve, and fill with solder, as in Fig. 6. Cut off the sleeve and file or rasp the solder smooth.

Copper pipe may be bent by filling it with sand or rosin. If rosin is used, first anneal the pipe by heating the full length. This is very important as any spot in the pipe not annealed would be likely to kink in bending. After the pipe is cool, a pot of rosin is melted and poured into it, or the pipe may be filled with sand.

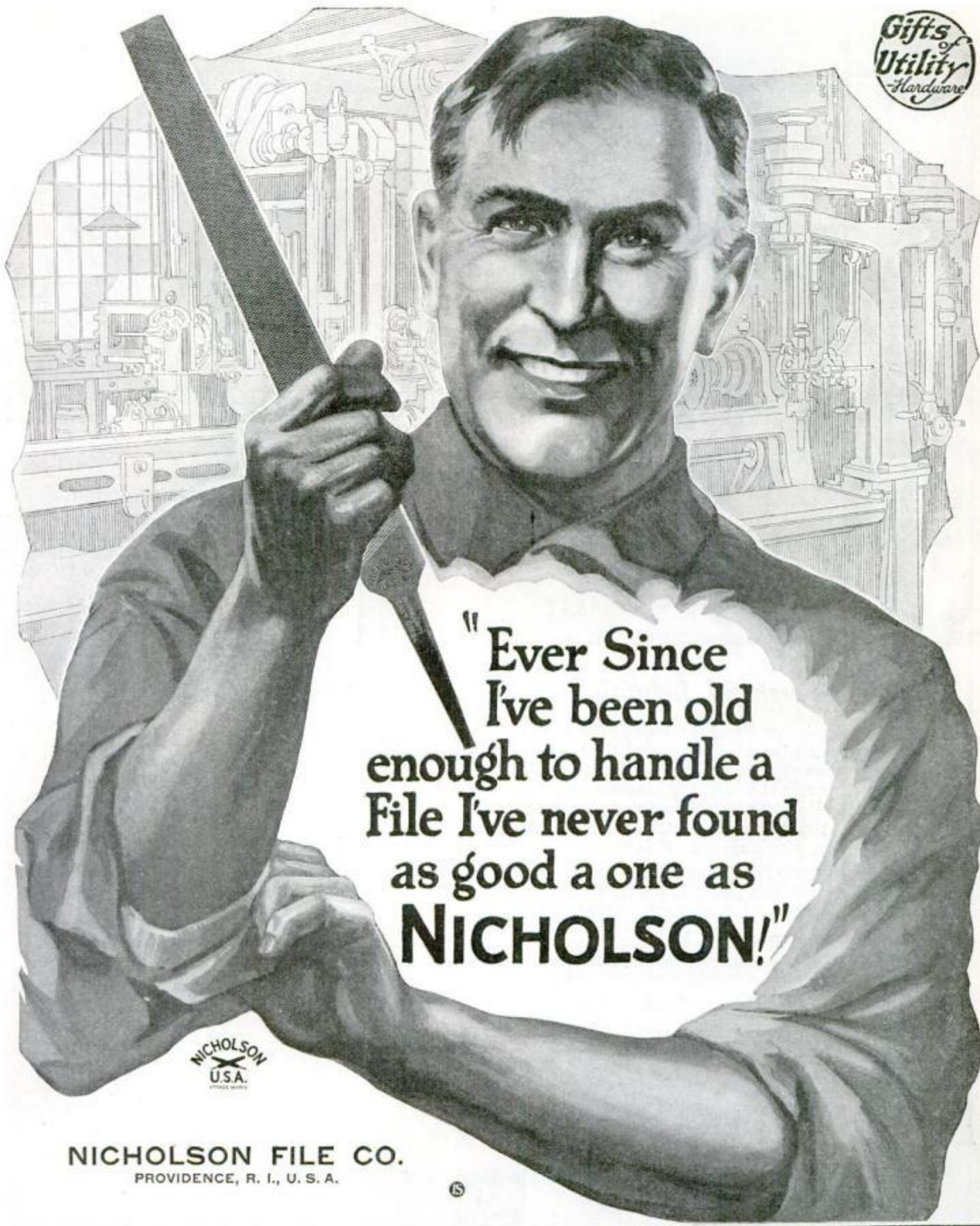
Copper pipe can be bent cold by using rosin. A wire templet is an aid in making bends accurately and always should be used except in work that does not call for any special exactness.

A BENDING block as shown in Fig. 3 or two iron pins inserted in a beam will be found very convenient for bending copper pipe. When placing pipe between the pins, always use wooden strips between pipe and pins to prevent kinks. Great care must be taken not to kink copper pipe, as kinks are not easily removed. Dummies or spanking tools for copper pipe are made of iron.

Large copper pipe may be bent by using as a bending block a plate of cast iron about 10 in. thick and 4 ft. square with a number of square holes in it. This plate is laid flat and two or three pins with square shank to fit the holes are placed in positions best suited to aid in making the required bend.

When sand is used for bending copper pipe, it is best to heat the pipe. If the heat spreads, it may be confined by pouring water on the pipe outside the

(Continued on page 108)

A detailed illustration of a middle-aged man with a friendly expression, wearing a dark shirt. He is holding a large Nicholson file diagonally across his chest with both hands. The background is a detailed line drawing of a workshop or factory interior, filled with various mechanical equipment, lathes, and workbenches.

"Ever Since
I've been old
enough to handle a
File I've never found
as good a one as
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THE Remington Portable is truly a universal gift—welcomed by people who write, much or little, the world over. It is saving the time of countless women. It is greatly assisting children in their school work, and properly training them for the future. It is indispensable to the college student of today. And men find in the Remington Portable a little helper always ready to lighten every writing task. It is the modern way to write.

The Remington Portable, complete with case, and in a beautiful Christmas container, \$60. Easy payment terms if desired. For sale by all Remington branches and over 5000 dealers.

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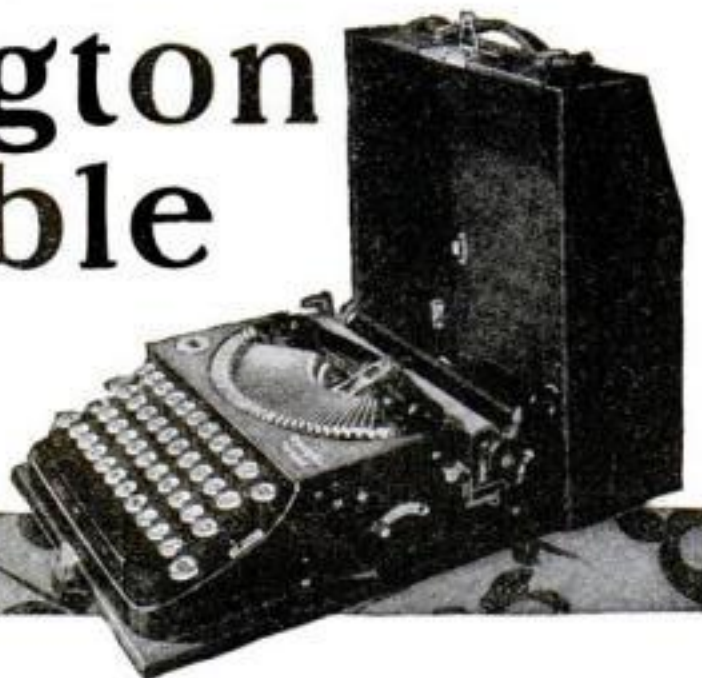
A distinctive model in ivory tone finish and handsome brown leather case. A limited number available at \$75.00 each.

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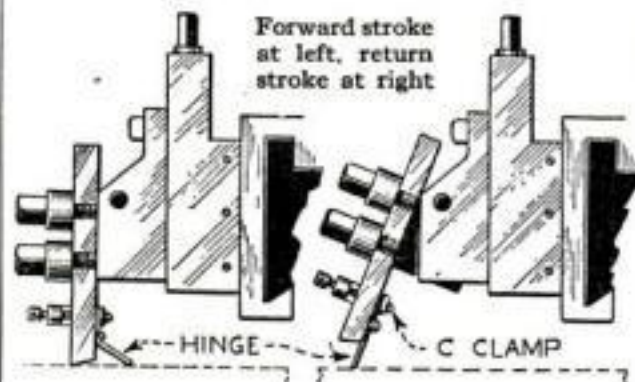
THE RECOGNIZED
LEADER—IN SALES
AND POPULARITY



Hinge Raises Planer Tool

THE dragging of a planer tool along the work on its return stroke, especially on a large job, tends to dull the tool edge.

In work of this nature I attach a small, freely acting hinge to the back of the tool



with a C clamp so that one leaf extends somewhat below the cutting edge of the tool. The hinge naturally folds out of the way on the forward stroke; but on the return, after the tool has cleared the work, the leaf raises the tool.—J. A.

Tricks in Bending Pipe

(Continued from page 106)

guide marks. The bend then is made on the bending block, with a wire templet as a guide. Tarnish and scale left on the pipe after cooling may be removed by swabbing it with muriatic acid.

Bends in brass pipe may be accomplished by practically the same methods as for copper. If brass pipe is heated for bending, care should be taken, as brass has a much lower melting point than copper. If the bend must be held to an exact radius, the pipe should cool slowly so that the contraction will be reduced to a minimum.

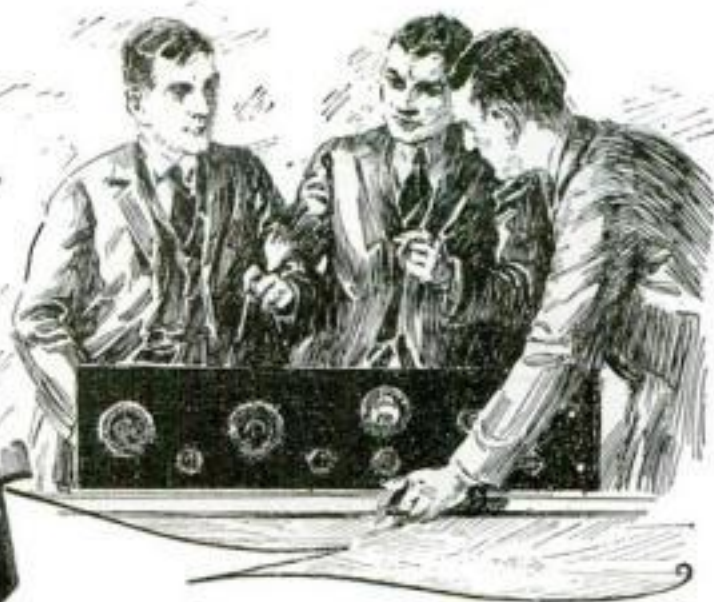
In bending small brass pipe up to $\frac{3}{4}$ in., the best method is to bore a hole in a piece of "two by four" and grip this in the vise. Insert the pipe in the hole and apply heat with a blowtorch (Fig. 3). By keeping pressure on the pipe with one hand and playing the torch flame with the other, the pipe will bend as soon as it is hot enough.

Brass railings usually are made of tubing and the method of bending is about the same as for copper pipe. It is customary to leave the rosin in the tube after bending, to resist dents while in service. As brass tubing burns easily, it should be very carefully annealed.

Iron pipe, if heated properly, may be bent without sand, provided the bend is not too short, but it will swell at the sides unless sand or rosin is used. These swells can be removed by squeezing the pipe in a vise before it is cold; it may be necessary, however, to apply more heat.

In making a bend close to a threaded end, always screw on a coupling to protect the thread. For bending a short piece of pipe, screw a coupling on one or both ends and use a length of pipe for a lever. The couplings should be cooled with water before bending.

Large pipe that cannot be threaded after the bend is made, must be cut to the exact length before bending. A quick and easy way to get this measurement is to have two wire templets of the bend. Straighten one of them for the measurement and keep the other in shape as a templet.



The shell is ORANGE
Bakelite—the base genuine
Thermoplas

The More You Know About Radio the Better You Will Like This Socket

If ever a device were designed to increase the efficiency of all receiving sets, it was this new socket by the Master Builder. Radio engineers praise it—new set builders marvel at its ease of installation and the clear, loud reception obtained that bespeaks the absence of losses—many old-timers have even rewired their sets to establish new distance records and enjoy clearer reception with this better socket.

You'll like its construction, embodying a minimum of both insulation and metal—capacity absolutely minimized *without sacrifice of mechanical strength*. And its base of ebony Thermoplas in beautiful color contrast with the thin shell of orange Bakelite adds as greatly to the appearance of any set as the construction does to its efficiency.

You'll like its contacts (the source of losses and noise in most sockets); they are radically new in design, formed of phosphor bronze and *silver* plated—because the contact resistance of silver does not increase as it stands exposed to air. Then, too, electrical losses are minimized by providing maximum spacing between terminals, both in the insulation and in the air.

You will like the way the tube is inserted and removed without turning—which prevents twisting the bulb from its base. You will like its appearance—its small size—its neatness. You will like its silvered posts with slotted nuts that are fastened *well* with either screw driver or wrench. You will like the way the terminals are arranged for soldering—extra long so that they may be bent down where under-wiring is desired—and provided with ears to hold the wire in place for soldering. And best of all you will like the price, 90c. *This socket that meets the specifications of the most exacting radio engineer costs no more than most of those on the market today!* If your dealer has not yet been stocked, you can be supplied direct from factory at regular price plus 10c for packing and postage.

THE CUTLER-HAMMER MFG. CO.

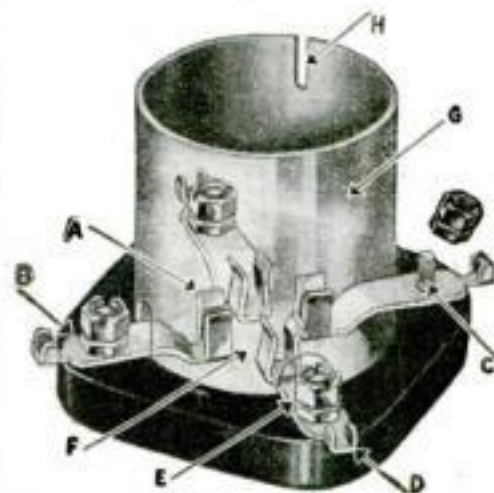
Member Radio Section, Associated Manufacturers of Electrical Supplies

Works: MILWAUKEE and NEW YORK

"Built By The Master Builder"

C-H

*These Exclusive
Features Assure Better
Reception*



A
Perfect contact. Both sides of tube prong cleaned when inserted—no contact or wear on soldered end.

B
All metal parts *silver* plated—perfect contact for the life of the set. Silver may tarnish but its contact resistance does not change.

C
One piece contact construction. The binding post is NOT a part of the circuit—the wire to the socket always touches the contact strip which carries the current direct to the tube prong—no joints to cause losses.

D
Convenient terminals for soldering—full length to allow bending down for under-wiring. Ears hold wire in place for soldering.

E
Extra handy binding posts—tight connections with either wrench or screw-driver. Lock washers hold terminals rigid.

F
Wide spacing of current carrying parts both in air and insulation—true low-loss construction.

G
A minimum of both metal and insulation for low capacity. Shell of thin Bakelite—the base of genuine Thermoplas.

H
The tube is held in place by merely a vertical motion—no twisting to separate bulb from base.

The attractive orange shell helps identify this better socket, but the famous C-H trade mark both on the socket and on the orange and blue box is your genuine protection.

C-H

RADIO SOCKET

At Last! Radio That Satisfies The Music Critic

E. F. Rauland, Pres.
Rauland Manufacturing Co.,
2650 Coyne Street., Chicago, Ill.

THE
CHICAGO DAILY NEWS
EDITORIAL ROOMS
August 6, 1924.

My dear Mr. Rauland:

I want to express my great pleasure in witnessing the recent test of amplifying transformers in your laboratory, and in selecting, from different instruments tested, the one which seemed to me to reproduce most exactly the artist's original tones. I was indeed gratified to learn, after the tests, that the instrument which I had repeatedly selected as by far the most successful in reproducing, not alone the music, but even the very personality of the artist, was none other than your own new "Rauland-Lyric" Transformer.

I feel confident that music lovers everywhere will appreciate the contribution you have made to their enjoyment in the creation of this reproducing instrument.

Very truly yours,

Music Critic,

Maurice Rosenfeld
Chicago Daily News

Price, \$9.00



In placing his mark of approval upon Rauland-Lyric, Mr. Maurice Rosenfeld has invested Radio with a new beauty and dignity. His words carry positive assurance, to music-lovers and trained musicians, that they can now admit Radio to their field of appreciation and enjoyment, with the certainty that all voices and instruments will be reproduced with their original and distinctive Tone Quality.

Mr. Rosenfeld, a
The RADIO KEY BOOK
contains the clearest explanation
ever given of the nature
of audio amplification and
equally valuable discussion of
many other subjects in Radio.
Sent for 10c, coin or stamps.

Rauland-Lyric
AN
ALL-AMERICAN
TRADE MARK
TRANSFORMER

veteran among metropolitan music critics, selected Rauland-Lyric, upon the sole basis of Tone Quality, from a group of the world's best audio transformers.

Karleton Hackett, famous critic of the Chicago Evening Post, pronounced Rauland-Lyric a "distinct advance in the musical quality of radio reproduction."

You can have, in your home, the amplifying instrument which has been commended by eminent critics. Rauland-Lyric can be installed in your present set, or one that you may buy, to replace any ordinary audio transformer. Ask your dealer.

RAULAND MFG. COMPANY

Pioneers in the Industry
2668 Coyne St., Chicago, Ill



Standard

Audio Frequency Transformers

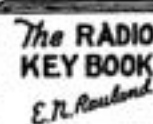
"All-American for Reliability"
Ratio 3 to 1.....R-12, \$4.50
Ratio 5 to 1.....R-21, 4.75
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Built by precision methods in a modern plant, All-American Standard Audios meet the demand of the public for a dependable, high-quality transformer at a price made possible only by enormous production.

Long Wave Transformer

For best amplification of intermediate frequencies: 4,000 to 20,000 meters (75 to 15 kilocycles)....R-110, \$6.00

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For tone quality in a third stage, or for Loud Volume with Clearness.
Input type.....R-30, \$6.00
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The RADIO
KEY BOOK
E. F. Rauland



Self-Tuned

Radio Frequency Transformers

"Wound to Suit the Tube"
Effectively amplifying all frequencies within the radiocast range.
For "199" Tubes.....R-199, \$5.00
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(Filter or Input). It gives superior results, filtering out a 30 kilocycle frequency with high selectivity and no side-band distortion....R-120, \$6.00

Radio Frequency Coupler
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Universal Coupler

Sets a new standard of efficiency as an antenna coupler. As a radio frequency transformer in tuned stages it is unsurpassed.....R-140, \$4.00



Precision Made

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Largest Selling Transformers in the World

Old Bill Repairs an Engine

(Continued from page 98)

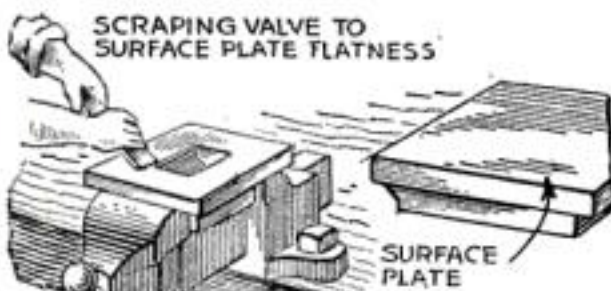
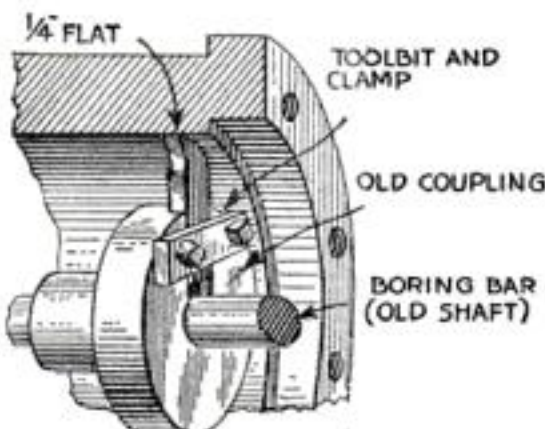
cylinder was raised a little more, using sheet-iron shims, and adjusted sidewise so that the tool touched equally on all sides. The other end was centered in the same manner. The first end was checked, and another adjustment made, as it had shifted a little when the second end had been trued up. Presently the cylinder was clamped to Old Bill's satisfaction.

"Always set up a job like this by the counterbore, and not by the worn surface," he said. "If you had used the bore of the cylinder, you would get your new bore out of square with the end of the cylinder, and the piston rod would not travel in a straight line. Now start a roughing cut, and let's get the job done."

He was off to look at the other parts. He found the new piston progressing nicely, but the machinist with the brasses seemed to be perplexed.

"I think that we shall have to have new brasses on the crankpin end," the machinist said.

Old Bill looked at them. They were worn badly, and he saw that they could



Setting up the boring bar and scraping the engine valve to surface-plate accuracy

not be closed any more. But to wait for a pattern and castings for new ones would be too long.

"We will babbitt the brasses," he said. "Drill a number of holes up in the sides about 1/8 in. deep to hold the babbitt and then tin them well. Be sure that they are thoroughly clean before you try to tin them. Heat them on a plate over the forge fire hot enough to melt the solder. Drop some acid on and rub the solder all over the inside with a stick. Make sure that you get all the spots tinned. Wipe all the loose solder off with some waste while the brass is still hot, and if it shows bright all over, you have done a good job, but if it shows any brass, you will have to work some more."

The machinist seemed to think this more trouble than necessary, especially since he was to put holes in to hold the babbitt, so Old Bill went on to explain:

"Unless we can get the babbitt united to the brass, we shall have trouble from hot boxes. The heat that is formed will

(Continued on page 112)

**TRF-50**

A handsomely carved cabinet—a most efficient 5-tube circuit with Unit Tuner—built-in Magnavox Reproducer. The receiver you have been waiting for; study the details.

MAGNAVOX

Receiving Sets which establish an authoritative standard of excellence for the daily enjoyment of radio.

LONG identified with the most efficient radio reproducing and amplifying equipment, Magnavox has developed its new Receiving Sets under conditions insuring superior design, precision of manufacture, and a gratifyingly low cost.

Exacting tests prove that the Magnavox Receiver is not only extremely simple to operate but one whose daily performance will satisfy the most discriminating.

- ⑤ Magnavox Radio Receivers, Vacuum Tubes, Reproducers, Power Amplifiers, and Combination Sets are sold by reliable dealers everywhere.

THE **MAGNAVOX** COMPANY, Oakland, California
 New York: 350 West 31st Street San Francisco: 274 Brannan Street
 Canadian Distributors: Perkins Electric Limited, Toronto, Montreal, Winnipeg

Receiving Sets

TRF-50 (as illustrated above)—is a 5-tube tuned radio frequency receiver with carved doors and built-in Magnavox Reproducer \$150.00

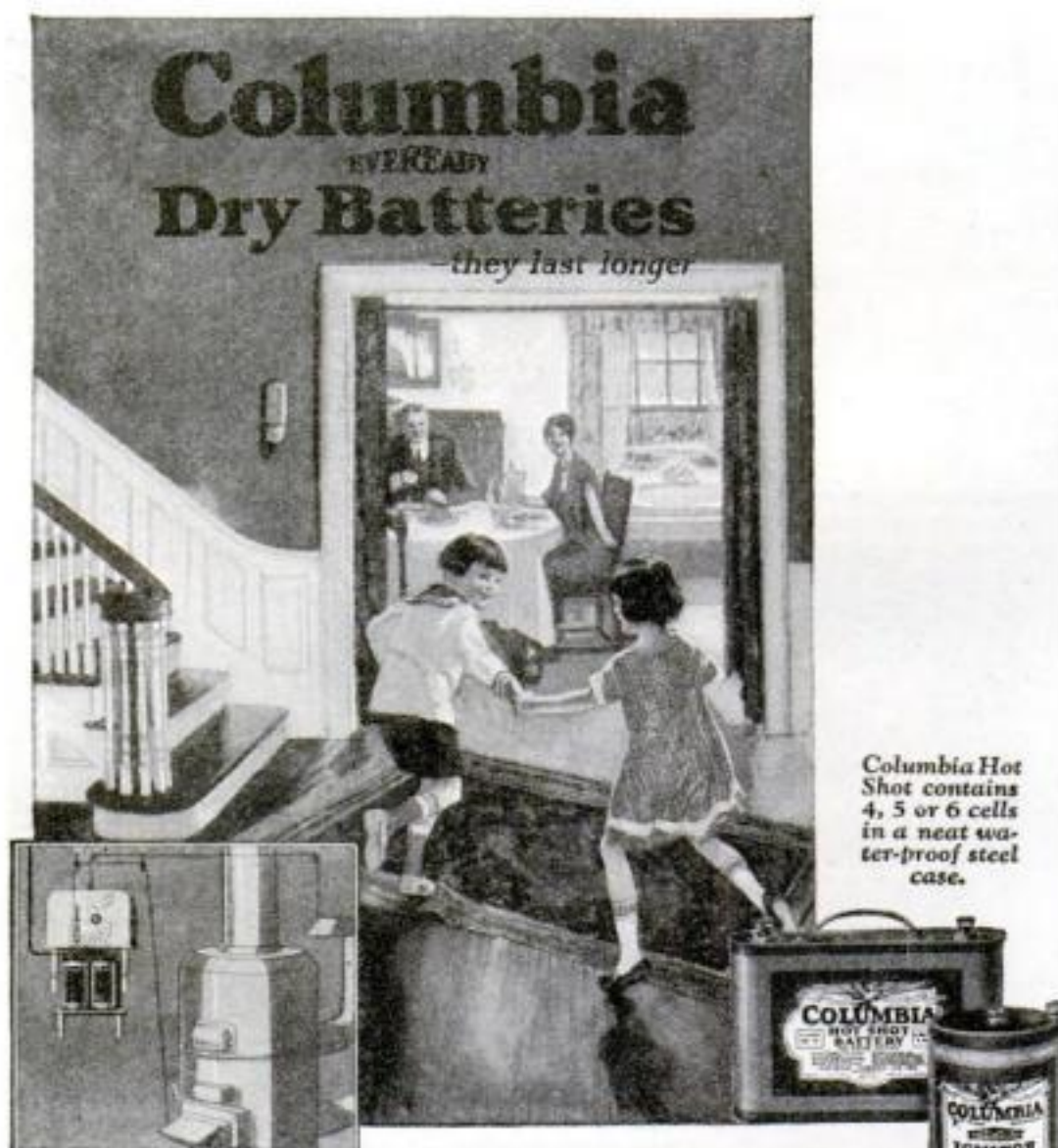


TRF-5 is identical with TRF-50 but encased in smaller cabinet without built-in Reproducer . \$125.00



Type A and Type D—Six-volt storage battery amplifier and detector tubes with standard base \$5.00

Watch-dogs of comfort



HOOK Columbia Eveready Dry Batteries to your heat regulator and stop running up and down stairs all day to tend the fire. A thermostat will tell the batteries your rooms are too cold or too hot—then the powerful Columbia Evereadys will open and close the drafts: these save you thousands of steps.

Columbias are an independent source of electrical energy always on the job even though all other power fails. In its water-proof steel case the Columbia Hot Shot laughs at leaky pipes, at dust, at dirt. Connect it with the heat regulator and say "Ha! Ha!" to cold weather and the coal man. Feed the furnace twice a day and let these powerful batteries boss the heat for you.

Don't just ask for a "dry cell." Ask for Columbia Eveready Dry Batteries by name and get 100% efficiency. Columbia Eveready Dry Batteries are sold by electrical, hardware and auto accessory shops, marine supply dealers, implement dealers, garages and general stores. Columbia Eveready Ignitors can be purchased equipped with Fahnestock spring clip binding posts at no extra cost to you.

Manufactured and guaranteed by

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| —gas engine ignition | —tractor ignition | —calling Pullman porters |
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| —buzzers | alarms | and outbuildings |
| —motor boat ignition | —protecting bank vaults | —running toys |
| —heat regulators ✓ | —electric clocks | —radio "A" |

Old Bill Repairs an Engine

(Continued from page 110)

not flow out where it can get away to the air if it has to travel through a layer of scale and dirt. But if the babbitt is what you might call soldered to the brass, the heat will travel through as though it were one piece of metal."

The valve next engaged his attention. It was progressing nicely.

"I want this valve scraped to the surface plate so that we can save time in fitting the seat," Old Bill said. "If you get the valve perfect before you get on the seat, you can save a lot of hard work, as well as time, and we need time, for we can't let the foundry lose more than one day. We shall have to hustle and re-assemble the engine by tomorrow noon. When you get the valve scraped, get the shaper ready to take the cylinder, and we will

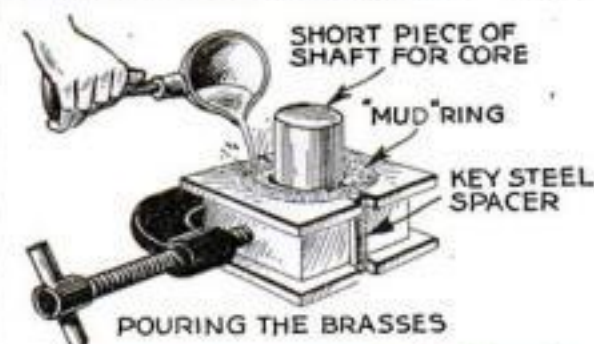


Diagram showing method of tinning the brasses and lining them with Babbitt metal

plane the seat. Be sure that you have tools that will get in all right."

After having attended to some of his other duties Old Bill drifted around to see how the boring of the cylinder was getting along. Jack looked worried. He had taken two cuts through, and had got out all of the worn surface, but it was still rough. There was a chattery place, too.

"I have tried 'most everything I know, and I can't make the old lathe bore smooth," he complained. "It seems like the slower I go and the finer the feed I use, the worse it gets!"

"I'm not surprised," was Old Bill's comment. "You have neglected the first rule on doing smooth work. You have not taken up the slack."

"But I have," Jack retorted. "The center is tight, and the spindle bearing is tight."

"That may be, but there is a lot of spring in the bar, and you have not taken that out," Old Bill said. "Let's see the tool you are using. Too pointed. Grind it off so that it will be about a quarter of an inch flat, and bring the oilstone with you."

Old Bill tapped the tool out so that it barely touched, and then turned the bar

(Continued on page 114)



*Boys! Ask Dad
to give you the lifetime gift this Christmas
— a wonderful Ives Electric Train*

YOU boys will experience one of the greatest joys of your life when you see, on Christmas morning, a wonderful Ives Electric Reversing Locomotive in front of the bright, realistic station. There it stands, waiting for its first run over your newly-established branch of the Ives Railroad System—a system with trackage sufficient to extend from New York to San Francisco, including branch lines all over the country.

Think of a locomotive that is an exact model of the giant electric locomotives used on the New York Central and other great American railroads! A locomotive that will reverse itself, electrically, at any position on the track, without being touched by hand! A locomotive that switches its own cars, shunts them into sidings, or speeds—with electric headlight ablaze and each car illuminated—around the track and couples automatically to the front of the train.

For the first time in the history of American toy-making, a locomotive can be made to reverse, electrically, at will. This operation which, heretofore, could be accomplished only by a mechanical device on the locomotive or track, can now be done by simply working an electric control-switch located away from the track. This revolutionary and exclusive Ives reversing feature was invented by prominent Westinghouse engineers and perfected in the laboratories of the Ives Railway Shops.

Ives has the most complete railroad system ever devised. There is an unlimited variety of bridges, passenger and freight cars, switches, tunnels, stations, automatic bell signals for crossings, automatic block semaphores, etc. These are of the latest design and are true copies of equipment used on the leading railroads.

Ives Toys make happy boys

Ask Dad to give you one of these wonderful Ives Electric Reversing Locomotives this Christmas. There's every conceivable accessory with which to equip a system. Remember, there's an Ives outfit to suit every purse. They include mechanical trains for the boy of 3 years and upward, to the most wonderful, complete electric system. Prices range from \$1.50 to \$50. At the best toy, department, electrical and hardware stores. Send for brilliantly illustrated 32-page book in full colors, which shows the complete Ives line.

Mail this coupon for the
Ives Book—TODAY!



THE IVES MANUFACTURING CORP'N
197 Holland Ave., Bridgeport, Conn.

I enclose 10 cents (U. S. Stamps or coin) for your 32-page book in full colors, showing the complete line of Ives electric locomotives, freight and passenger cars, signals, etc.

Name.....
Address.....
City..... State.....

THE IVES MANUFACTURING CORPORATION
197 Holland Avenue Bridgeport, Conn.

IVES **ELECTRIC** **AND** **MECHANICAL** **TRAINS**



Old Bill Repairs an Engine

(Continued from page 112)

a trifle. He could see a little dust coming off at one corner of the tool. Old Bill brought the tool out of the hole and rubbed off this corner with the oilstone. He repeated the performance until the tool scraped from one end to the other. Then he tapped the tool out a bit more.

"You will take too much," Jack cautioned.

Old Bill smiled. "Just watch, and I will tell you why," he said.

OLD BILL started the lathe and threw in the feed. He was taking more than a scrape; he was taking about .01 in., and the carriage was moving pretty rapidly, too. Jack looked worried. He knew that he had had a finer feed on.

"If I were to use as fine a feed as you had," Old Bill explained, "the tool would be dulled before we reached the end of the cut, so I put on a coarse feed to be sure that the tool will be about as keen at the end as at the beginning. That will insure the bore's being the same size from one end to the other. I am taking a heavier cut than you did, so that all the spring and play will be taken up, and we won't have to bother about the weight of the bar. Taking out this much puts the parts under some load, so that all of the spring and give will be alike all around the bore. The tool is honed so that it will leave a smooth and true surface. Feel it."

Jack felt. It was smooth. He had expected to see big feed marks, but there was none, and the tool was curling chips off without any chatter! He watched it, fascinated, until it went out the other end.

"Easy, isn't it?" Old Bill asked. "Now caliper the bore and make sure that it is the same size at both ends, and if it is all right, take it out and truck it over to the shaper that is all ready for it."

Old Bill presently came over to the shaper. They had the casting hung up on the carriage of the shaper, and were trying to clamp it in place.

"YOU are going to too much trouble, boys," he said. "Put a bolt through the center, and some paper between the surfaces, and that is all that you will need. See if the machine is level crosswise, and if it is, adjust the casting so that it is level crosswise too, and your set-up is made."

Just then the machinist who was making the new piston came over to get the size of the cylinder, and Old Bill could see in the distance the babbitt flying from the brasses being bored, and he knew that he would have the foundry's engine running in fine shape in time for tomorrow's heat. It was now getting along toward quitting time, so he went toward his office with the feeling of having done a good day's work.

Coming Shop Features

ANOTHER "Old Bill" story by Mr. Ellis, "Handling Rush Repair Work Successfully," is scheduled for early publication. Other features include "Methods and Tools that Have Saved My Time," by E. C. Fellows, and "How to Make the Most of a Drill Press," by F. J. Wilhelm.

The People's Telephone

The telephone knows no favorites. It does the bidding of the country store and of the city bank. It is found in the ranch house kitchen and in the drawing-room of the city mansion. Its wires penetrate the northern forest, stretch across the prairie, are tunneled under city streets.

The telephone knows no favorites. Its service to all the people is of the same high standard—the Bell System standard. Twenty-four hours a day it carries the voices of all. For the benefit of all, the long-distance circuits are kept in tune. Numberless discoveries and improvements developed by the Bell System have made the telephone more useful for all the people. In America, all can afford the telephone, for Bell System service is the cheapest, as well as the best, in the world.

The telephone knows no favorites. It is not owned in any one locality or by any particular group of men. It is owned by 350,000 stockholders, who represent a cross-section of the thrift of the whole country. The owners of the telephone are those it serves.

In America to-day the 15,000,000 telephones of the Bell System contribute to the security, happiness and efficiency of all the people.



AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

BELL SYSTEM

One Policy, One System, Universal Service

NEW VEST POCKET ADDING MACHINE

Adds as rapidly and accurately as a \$300 machine, yet fits the vest pocket. Mechanically perfect. Easy to operate—nothing to get out of order. Everyone who uses figures should own one. Counts Up to 999,999,999

\$2.95

Total visible at all times. A pull of the finger clears it. Don't carry a pocket full of pencil stubs and scrap paper to do your figuring. Carry a Ve-Po-Ad. **10 Days Trial** Send no money. Just name and address and we will send machine postpaid. Pay postman on delivery \$2.95. Use it for 10 days to prove it does all we claim. If not perfectly satisfied we will refund your money. Limited supply. Send order today. Reliable Adding Mach. Corp., Dpt. 25, 170 W. Washington St., Chicago, Ill. Here's a money maker. Everybody wants one. Splendid profit. Write for special offer.

AGENTS

FORDS START INSTANTLY AT ZERO

Wonderful invention starts Ford instantly in the coldest weather—users say doubles mileage—common to get from 40 to 44 miles per gallon—gives motor more power and quicker pick-up—VAN LEEUWEN of MASS. says: Your claims for increased mileage are correct; a big saving is made—WORRA of IOWA says: The SUPER saves three to seven dollars each month, puts new life into motor.

MARVELOUS DEVICE—COMPLETE COMBUSTION Automatic in its action—installed in 10 minutes—converts every atom of Gasoline and Kerosene into real power—prevents liquid fuel from passing into the cylinders, thus avoiding carbon formation and oil dilution.

EVERYBODY SATISFIED—EASY TO SELL Everyone praises the SUPER—users say it performs miracles to a Ford—Distributors say "everybody buys and is pleased"—sells like hot cakes, every order is a RUSH order.

\$60.00 TO \$150.00 PER WEEK EASY The SUPER is a whirl-wind seller and takes hold in a locality like wildfire. Big money is possible because a trial sells itself—after that everybody talks about it—spare time or full time—they all pay well. A trial of the SUPER convinces anyone.

Men Wanted Everywhere To Introduce Sent On 30 Days' Trial
WEEKS SUPER CARBURETOR CO.
1304-708 Fond Du Lac Ave. Milwaukee, Wis.

What a Big Railroad Man Says about Lionel



H. E. Byram, President of the Chicago, Milwaukee and St. Paul Railway

Chicago, Milwaukee & St. Paul Railway Company
H. E. BYRAM - President
48-52 East 21st Street, New York City
October 22nd 1924

The Lionel Corporation,
48-52 East 21st Street,
New York City.

Dear Sirs:

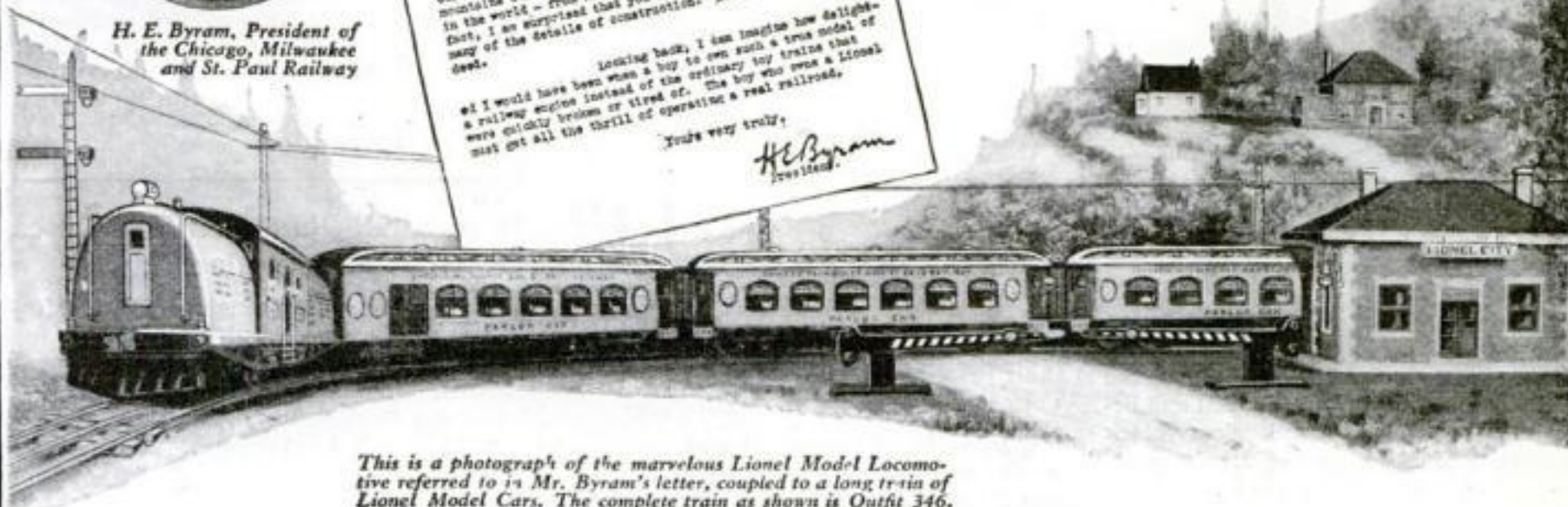
I have just examined one of the Lionel locomotives modeled after those of the Chicago, Milwaukee and St. Paul Railway which haul our trans-continental trains over the western mountains.

You are to be congratulated on the very close resemblance which your miniature locomotive bears to our 345 ton monsters which haul long trains across the mountains over the longest electrified railroad system in the world - from Burlington, Mont. to Puget Sound. In fact, I am surprised that you have been able to show so many of the details of construction. It is very real indeed.

Looking back, I can imagine how delightful a railway engine instead of the ordinary toy trains that were quickly broken or tired of. The boy who owns a Lionel must get all the thrill of operating a real railroad.

Yours very truly,
H. E. Byram
President.

"The Boy who owns a Lionel must get all the thrill of operating a real railroad"



This is a photograph of the marvelous Lionel Model Locomotive referred to in Mr. Byram's letter, coupled to a long train of Lionel Model Cars. The complete train as shown is Outfit 346.

THAT is the statement of a man who knows the latest developments in railroading.

He knows, too, that boys always want trains and equipment that are true to life—that not only *look* like real trains, but *operate* as real trains do.

For 25 years Lionel has specialized in the manufacture of model electric railroads—not mere "toys". Since 1900 Lionel products have been "Standard of the World". Lionel has always pioneered in the development of electric model trains.

The only difference between Lionel and real trains is the size.

Take father with you to see Lionel Trains demonstrated. He will get the same thrill out of them that you do. The power, the beauty, the *realness* of Lionel Trains and Accessories is enough to delight anybody.

When a fellow buys a Lionel Model Train, Crossing Gate, Signal Tower, Switch, or any of the many other realistic Lionel railroad devices he knows that

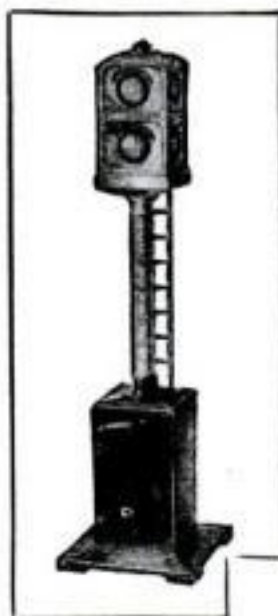
he has really *got* something of permanent and lasting interest and value.

Complete Lionel "O" Gauge Model Railroads are priced as low as \$5.75—and a marvelous train for Lionel "Standard" Track, with *illuminated coaches*, at \$16.50. (Prices slightly higher in the Far West.) There are many other complete outfits to suit every purse.

Be sure to see these wonderful trains in your town at department, electric, sporting goods, toy or hardware stores.

Send for this Catalog

And don't fail to write for your copy of the wonderful 44 page Lionel Catalog—illustrated throughout in 4 colors. It is **Free**.



Lionel Automatic Train Control—The greatest achievement in model railroad engineering. Starts and stops trains automatically. Just one of the many wonderful realistic railroad devices in the Lionel Line of Accessories.

The Lionel Bell Warning Signal—As the train approaches the grade crossing, bell automatically rings—stops ringing as soon as train has passed. Steel construction throughout.



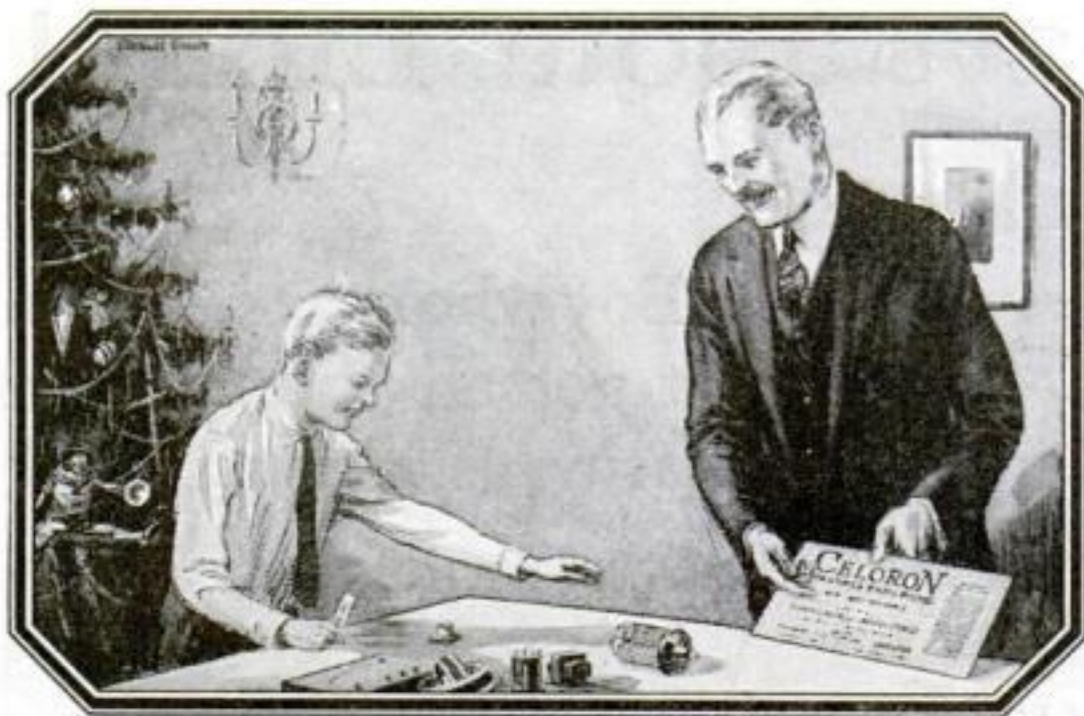
Lionel "Multivolt" Transformers. Ever-reliable power plants. Run all trains best. A type for every size train.

The LIONEL CORPORATION
DEPT. B

48-52 East 21st Street New York City

LIONEL ELECTRIC TRAINS
MODEL RAILROAD ACCESSORIES
"MULTIVOLT" TRANSFORMERS

CELORON



"Gee, dad, that's a peach!"

CHRISTMAS morning — and with it gifts that make the radio fan's heart skip a beat or two. There are tubes, batteries, a tuning-coil and beside them a beautiful, glossy-black panel. The best part about the panel is that it is a Celoron panel.

Dad used his old bean when he selected a Celoron panel. He picked Celoron because it is a bakelite panel and furnishes the insulation that delicate instruments need to give the best results. He knows that it doesn't pay to skimp in buying a panel.

Celoron has high dielectric strength and it is practically indestructible. You can drill, tap, saw and bore a Celoron panel without fear of its chipping or cracking. It is not affected by atmospheric changes, and it never softens, warps or buckles.

You can buy Celoron in black or mahogany finishes. These never lose their lustre or become discolored. They improve with age.

Celoron has been tested and approved by the U. S. Navy, the U. S. Signal Corps, by leading radio manufacturers, and by thousands of radio fans all over the country.

Ask your dealer to show you his assortment of Celoron bakelite panels.

CELORON A Bakelite Panel

Diamond State Fibre Company
Bridgeport, Pa., and Chicago, Ill.
Branches in Principal Cities
Toronto, Canada London, England

Send for FREE booklets

We have prepared two interesting booklets, "Getting the Right Hook-up with Celoron" and "Vulca-wood—the New Cabinet Material," which contain many valuable suggestions for building and operating a radio set. Send for your copies, now. They are free.

Diamond State Fibre Co., Bridgeport, Pa.

Please send me without charge copies of "Getting the Right Hook-up with Celoron" and "Vulca-wood—the New Cabinet Material."

My radio dealer's name is

Name

Address

\$25.00 in PRIZES

See top of page 10 in front of book for details

"Buzz Boice" Makes It Easy To Do Hard Jobs

Hundreds of operations that take loads of time and lots of labor are quickly done with a

BOICE-CRANE Pony Bench Machine

Six machines at the price of one. So compact you need not build a workshop. Saws, sands, grinds, miters, tenons, rabbets and many other operations with ease and accuracy. Saws 1½ in. stock. Driven by ¼ or 1/3 h. p. motor attached to any light socket.

Write for descriptive catalog of Bench Machines, Band saws and Jointers.

W. B. & J. E. BOICE—Dept. S. A. 12—TOLEDO, OHIO.
"Largest Makers of small Bench Machines in the World"



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Guarantees
Satisfaction

\$4 Awards Offered for Photos of Ingenious Tools

GEORGE A. MOHL, a reader of POPULAR SCIENCE MONTHLY, describes in the article below an interesting and ingenious instrument or tool for measuring irregular areas.

If you are a mechanic, no doubt you have made at some time or other an especially useful or unusual tool or fixture to accomplish work that could not be done so easily with your regular tools. The chances are there was nothing on the market you could buy to serve the purpose of the tool you made, and, although it may have given service only on a few occasions, it probably paid for itself many times.

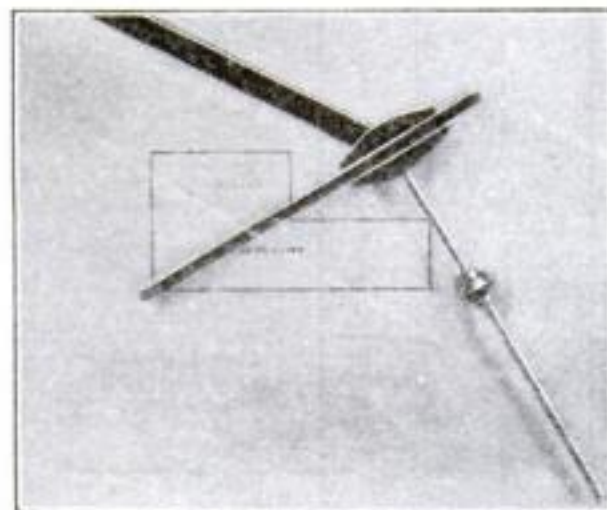
If you have made such a tool, send a clear photograph of it, with a brief description of its construction and purpose, to the Editor, Better Shop Methods Department, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York. For each photograph available for publication, POPULAR SCIENCE MONTHLY will pay \$4.

Homemade Planimeter Measures Areas of Irregular Figures

LIKE the average engineer or draftsman, I was without a planimeter for measuring the area of irregular figures such as on indicator cards, ground layouts, and engineering drawings.

"Why can't I make one?" I asked myself.

The homemade planimeter illustrated was the result. It cost very little except the time and labor in making it, and yet



As the tracing arm follows the outline, the movable wheel automatically indicates the area

it gives results correct to within one per cent of the exact area.

The instrument is made mostly of wood. The measuring rod, however, is a thermometer tube with graduations spaced 1/8 in. apart. Upon this rod a steel roller revolves and slides freely.

In use, one arm is pivoted to the drawing-board and the other arm is used to trace the outline of the figure that is to be measured. When the tracing point has passed around the outline, the roller gives a correct reading in square inches.

—GEORGE A. MOHL, Buffalo, N. Y.

THE Editor of the Better Shop Methods Department will be glad to hear from any readers who are interested in making a planimeter of this type and who would like to obtain working details and a full description.

Table-Talker



What greater gift?

Joy for the holidays—for all the year. Joy for the fellow who gets the gift—and for the family. Give it all—give a *Table-Talker*.

You're sure of its tone. Sure that it will always be loud yet pleasant, because its horn is matched to the unit. It reproduces every word, every note with vivid clarity—it makes the joys of radio *real*!

Brandes



*The name
to know in Radio*

Copyrighted by C. Brandes, Inc. 1924



© This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

For Christmas An Ingersoll

THERE'S no gift like a watch, nothing used so much, consulted so often, carried so long.

The New Yankee \$1.75

Dependable, as always, but with many new features of grace and beauty. With Radiolite dial, \$2.75.



Reliance Gold-Filled \$11.00

The 7-jewel thin model Reliance in a green or white 14-kt gold-filled case.



Waterbury \$5.50

A jeweled watch for \$5.50. 12-size; nickel case. Combines stamina with style. With "silver" luminous dial, \$6.50.

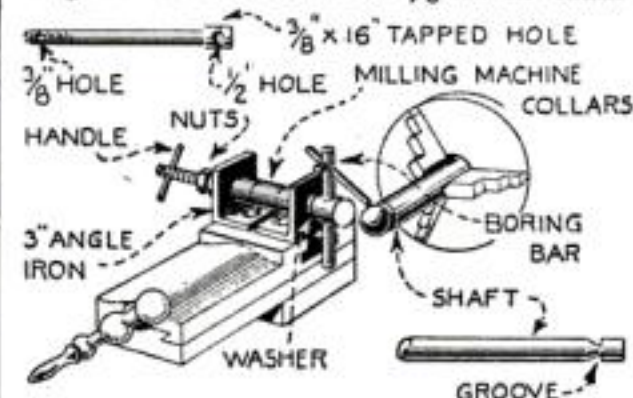


Quickly Assembled Fixture for Turning Balls

IN TURNING balls on the ends of a number of small shafts recently, where no great accuracy was required, I used the fixture illustrated.

Into 2 pieces of $\frac{1}{4}$ by 3 by 3 in. angle iron a $\frac{3}{8}$ -in. hole was drilled and reamed the exact height of the lathe centers. Then the pieces were bolted to the toolpost holder.

A piece of 1-in. cold-rolled steel 9 in. long was turned down to $\frac{7}{8}$ in. in diam-



When properly set up, this device turns ball ends on rods with fair accuracy

eter for 8 in. The $\frac{7}{8}$ -in. end was threaded for about 2 in. to take two $\frac{3}{8}$ -in. jam nuts.

A $\frac{1}{2}$ -in. hole was drilled through the 1-in. end of this piece to take a round boring bar. At right angles to this hole a hole was drilled for a $\frac{3}{8}$ -in. setscrew. Another $\frac{3}{8}$ -in. hole was drilled through the threaded end to take a handle.

Several $\frac{7}{8}$ -in. milling-machine collars were slipped on the shaft between the angle plates to act as spacers, and the angle irons were bolted to the toolpost holder. The two nuts then were tightened.

A groove was first turned in each of the shafts to the required depth. Then the ball ends were turned to the proper radius with the special fixture.

The adjustment for the radius is obtained by raising or lowering the boring bar or toolbit. When once the tool is properly set, turning the handle is all that is necessary to machine a ball.—J.A.

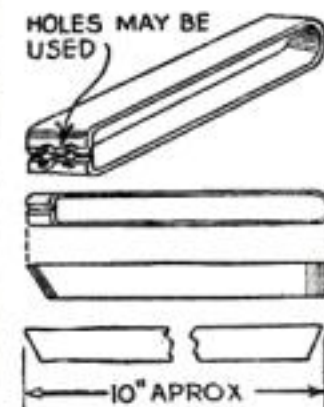
Tool for Removing Insulation Made from Hacksaw Blade

AN OLD machine hacksaw blade may be made into a time-saving tool for stripping insulation from wires.

Cut the blade to a length of about 10 in., making the cuts at an angle of 15 or 20 degrees, as shown.

Then grind off the teeth. Heat the ends and bend them up for about $\frac{3}{8}$ in. When cool, grind a blunt cutting edge on each of the upturned edges, with the bevel on the outside.

Next, heat the blade in the middle and bend together until the cutting edges touch; then restore the temper to the tool. This tool may be left with straight cutting edges or holes may be cut in the sharp edges.—S. W. B.



Easy to Draw Cartoons

When Shown in the RIGHT WAY

Some of the cleverest cartoonists and comic artists learned how to draw in their spare time by following Cartoonist Evans' Simple and Easy to Learn Method and are now MAKING GOOD MONEY. Send one of your drawings, and let Mr. Evans see if you have ability and receive the Portfolio of Cartoons and full details about the course. It is not expensive.

THE W. L. EVANS SCHOOL OF CARTOONING
825 Leader Building Cleveland, Ohio



Practical, Desirable CHRISTMAS GIFTS!

Gerstner TOOL CHESTS

are ideal. Get our catalog and select your own. A postal brings it.

H. GERSTNER & SONS
512 Columbia St., Dayton, Ohio



"WONDER" COLD PIPE, TUBING & BAR BENDERS

HAND and MOTOR OPERATED

14 Sizes of Machines

What it costs to bend pipe our way. Per bend.

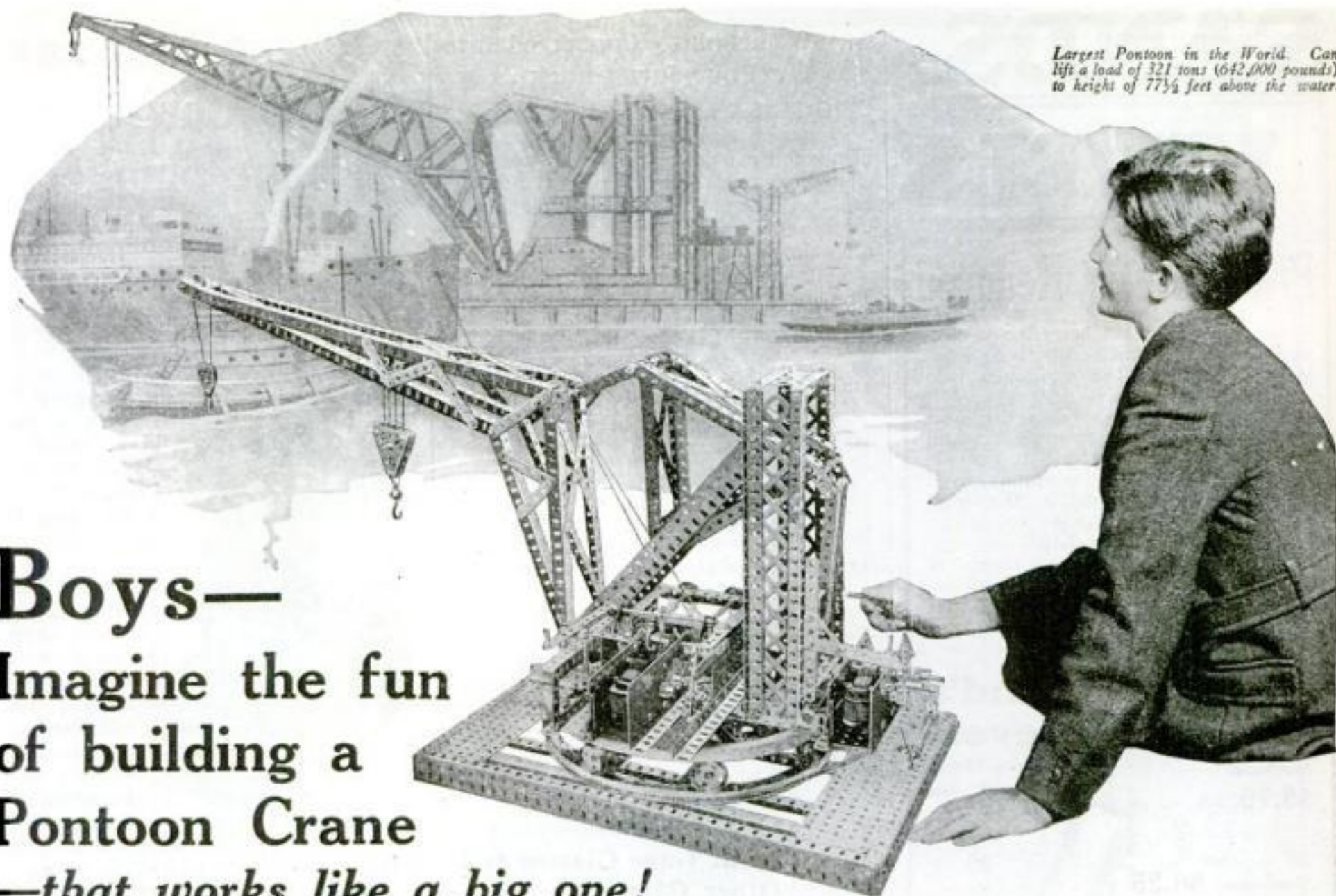
1" pipe 5 cents 4" pipe 25 cents

2" pipe 10 cents 6" pipe 60 cents

8" pipe \$1.00

Send for Catalogue.

AMERICAN PIPE BENDING MACHINE CO.
51 Pearl St. Boston, Mass.



Largest Pontoon in the World. Can lift a load of 321 tons (642,000 pounds) to height of 77½ feet above the water.

Boys— Imagine the fun of building a Pontoon Crane —that works like a big one!

WOULDN'T it be fun to be able to build a real Pontoon Crane? You can, right now if you have a Meccano Outfit. Think of the fun of making it all yourself and then having it work for you—lifting a load and swinging it just like the real crane in the picture above. And your fun never ends, for with these same parts you can build Signal Towers, Bridges, Automobiles—anything you can think of. You'll be the leader of all the boys.

There's no need to study with Meccano—a book filled with pictures showing just how the models are put together, comes with your Outfit.

Meccano parts are real engineering parts in miniature—gears, pulleys, couplings, girders, plates, etc., and they are so strongly and accurately made that they all fit together just exactly right. That's why it's dead easy to build with Meccano *but you must have the genuine Meccano*. No other toy can do the same—no other toy is just as good. Every Outfit is complete—there is nothing further to buy—the fun begins at once and never ends.



Prices of Meccano Outfits

No. 00 (Instructions for 40 models)	\$1.00
No. 0 (Instructions for 70 models)	2.00
No. 1 (Instructions for 106 models)	3.00
No. 1X (Has electric motor)	5.00
No. 2 (Instructions for 163 models)	6.00
No. 3 (Instructions for 207 models)	9.00
	and up to \$45.00

There is no limit to the number of models each Outfit can build, in addition to the examples shown in the Manual.

---This Book Sent FREE---

Fill in the coupon below, attach the names and addresses of three of your chums and we will send you absolutely free the Meccano book pictured above. It is intensely interesting and is beautifully illustrated. Tells all about the joys of Meccano and many pages of models are shown. There are 22 pages of pictures. Send for it today.

MECCANO COMPANY, INC., DIVISION K-2, ELIZABETH, N. J.
In Canada, Meccano, Ltd., 45 Colborne St., Toronto

For sale by most department stores, toy, hardware and sporting goods dealers. If your dealer can't supply you, we will fill your order direct on receipt of price.

MECCANO

Engineering for Boys

IMPORTANT NOTICE

Not all construction toys are Meccano. Meccano is the original Steel Construction Toy, has the greatest variety of parts and builds the most models. Insist on the genuine Meccano. This label is on every box.



These are the perforated flat strips originated by Meccano. They have holes spaced a half-inch apart, so that a bearing or fastening can be made wherever required. They are made of shining steel.

MECCANO
COMPANY, Inc.
Div. K-2,
Elizabeth, N. J.

I attach my name and address and those of three of my chums. In exchange please send me your Meccano book.

My name.....

Street.....

City..... State.....

SAND'S LEVELS

Prices Greatly Reduced

Increased production has effected savings in manufacturing costs that we are passing along to the craftsmen who use levels.

Every workman can now enjoy the convenience and accuracy of a genuine Sand's Aluminum Level. Once realize the lightness, permanent dependable accuracy and convenience of the Sand's Aluminum models and you'll never use any other.

24"
6 Glass
Aluminum
\$5.50

26" 6 Glass
Aluminum
\$5.75

28" 6 Glass
Aluminum \$6.25

30" 6 Glass Aluminum
\$6.50

All are genuine Sand's Levels with 4 plumbs, 2 levels, protecting lenses, crowned spirit tubes, black enamel bubble markings and built-in accuracy.

**Sand's
Levels**

Have Made
Good on
the Job
Over
29
Years.

Carpenters' Pine Levels

Every piece of wood used for a Sand's Level is air dried six months or more. All levels are hand finished and tested. Three coats of durable, weather-proof paint provide a lasting finish.

No.
678
(Illustrated)
24", 26", 28", 30"
2 Glass, \$1.35

No. 677—2 Glass,
12" to 20", \$1.25

No. 679—2 Glass,
24" to 30"

No.
118-BB
(Illustrated)
4 Glass.
Fully brass
bound, and with
brass end plates.
18" to 24" - - \$4.50
26" to 30" - - \$4.75
No. 118—Same as above,
plain.
18" to 24" - \$2.25 26" to 30" - \$2.50

Brass ends and brass
top plate with
view hole.
2 hand grips.
\$1.80

At Good Hardware Stores Everywhere,
or sent direct upon receipt of price
and your dealer's name and address

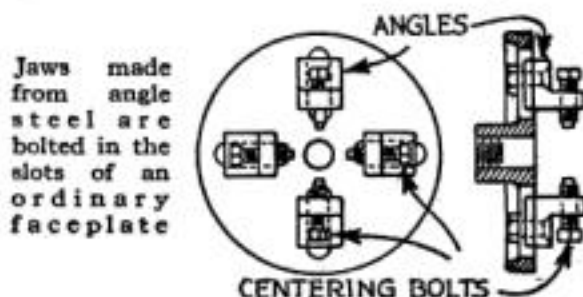
**SANDS LEVEL
& TOOL CO.**

5849 Fischer Ave., Detroit, Mich.

Lathe Faceplate Converted into a Four-Jaw Chuck

TO MAKE a common lathe faceplate more useful and to save the expense of a scroll chuck when there is not sufficient work to be done to warrant purchasing one, it is possible with very little expense and a small amount of labor to turn a regular faceplate into a jaw chuck.

Four short pieces of angle are required. The size and thickness depend upon the



size of the faceplate. For an 8-in. plate a $1\frac{3}{4}$ by $1\frac{3}{4}$ by $\frac{1}{2}$ in. angle, cut 1 in. wider than the slots in the faceplate, should be heavy enough.

The angle is machined on one side to fit snugly into the faceplate slots. A counter-sunk hole is drilled into the machined leg of each piece to receive the bolt for fastening the jaw to the faceplate, and a $\frac{5}{8}$ -in. hole is drilled and tapped in the other leg for the centering bolt.—F. C.

How to Cut Gage Glasses and Other Glassware

GLASS tubes, such as gage glasses, bottles, and other glassware, can be cut in a number of different ways. The strength of glass lies chiefly in its outside coat; even to scratch this coat lowers its strength. One of the simplest methods of causing a tube to break at a defined place, therefore, is to file it where the break is desired, using a saturated solution of turpentine and camphor as a lubricant.

To make the cutting solution for glass, pour the turpentine in a vessel and dissolve camphor in it until the solution is saturated, or has taken up as much as it will hold.

Another method is to wrap absorbent paper about the glass, allowing a space of $\frac{1}{8}$ to $\frac{3}{16}$ in. where it is desired to cut. Mark this point with a file and using a very small, hot flame from an acetylene torch or similar heater, heat the exposed portion, at the same time moistening the paper with water. During this operation the tube should be supported in such a manner that it can be revolved during heating and both ends protected when the fracture takes place.

The same result may be accomplished by protecting the tube on one side of the proposed fracture with asbestos tape, filing a groove and using a small wire bent to the circumference of the tube, with a projecting end for a handle. Heat this wire red hot, place it on the file mark and revolve it around in the tube to obtain equal heating, and then plunge the tube in cold water.

Sharp edges remaining on the tube may be ground off, or a paste of emery powder and water may be spread on a smooth iron plate or a piece of glass and the tube rubbed on this surface.—E. J. MORRISSEY.

Tobacco that says "Merry Christmas" to pipe-Smokers

Each year a number of Edgeworth Club members make a practice of distributing their favorite tobacco among friends as a Christmas remembrance. In some cases Edgeworth happens to be the recipient's "steady" tobacco. In other cases the gift serves as an introduction to Edgeworth—in fact, we know of instances where it has

created a rabid member of the Edgeworth Club.

To supply the gift spirit to Edgeworth at Christmas time the makers have provided appropriate wrappings for the 16-ounce glass humidor jar and the 8-ounce tin. Each contains Edgeworth Ready-



Rubbed. Each is packed in a good-looking decorated gift carton printed in colors. Prices—\$1.65 for the 16-ounce jar. The 8-ounce tins are 75c each. Please ask your tobacco dealer for the Edgeworth Christmas packages. If he will not supply you, we gladly offer the following service to you:

Send us \$1.65 for each 16-ounce jar, and 75c for each 8-ounce tin to be shipped, also a list of the names and addresses of those you wish to remember, together with your personal greeting card for each friend.

We will gladly attend to sending the Christmas Edgeworth to your friends, all delivery charges prepaid.

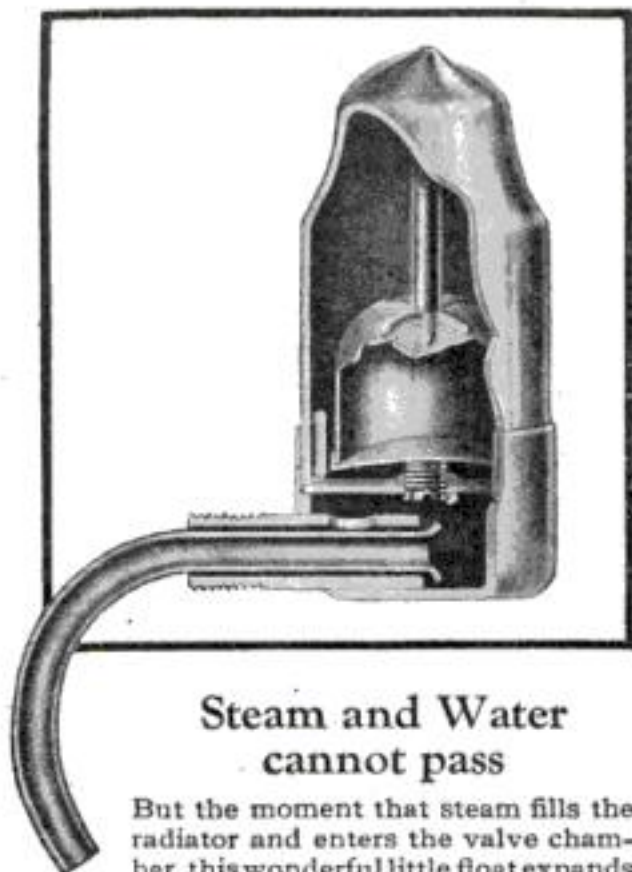
For yourself—It's just possible that you are not personally acquainted with Edgeworth. If that is so, send your name and address to Larus & Brother Company. We shall be glad to send you free samples—generous helpings both of Edgeworth Plug Slice and Edgeworth Ready-Rubbed. Smoke a few pipefuls and judge for yourself whether or not you wish to become a permanent member of the Edgeworth Club.

Edgeworth is sold in various sizes to suit the needs and means of all purchasers. Both Edgeworth Plug Slice and Edgeworth Ready-Rubbed are packed in small, pocket-sized packages, in handsome humidors holding a pound, and also in several handy in-between sizes.

For the free samples, kindly address Larus & Brother Company, 59 South 21st Street, Richmond, Va. If you will also include the name and address of your regular tobacco dealer, your courtesy will be appreciated.

To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one or two dozen carton of any size of Edgeworth Plug Slice or Edgeworth Ready-Rubbed for the same price you would pay the jobber.

Heating experts discover how to make cold radiators HOT



Steam and Water
cannot pass

But the moment that steam fills the radiator and enters the valve chamber, this wonderful little float expands from the heat and closes off the outlet by thrusting a pin up into the vent-hole, holding it tight shut as long as steam is present. Water, very likely to be present in steam pipes, lifts the float up until the vent is closed by the pin. With AIRID on guard, there is no chance for the radiator to spout like a geyser. An ingenious syphon pipe returns all water to the radiator.

*Clever contrivance costs \$1.60—
can be installed by anyone*

A REMARKABLE mechanical device is now being made to get full heat from steam radiators. The secret of it lies in its ability to distinguish between air and steam, or air and water, and to keep the radiator constantly free from air without permitting the escape of the other two elements. Hence the name AIRID, because it *rids* the radiator of cold air.

The Institute of Thermal Research in Buffalo, N.Y., worked for many years to perfect AIRID. They knew that it must not hiss with escaping steam, nor drip water. They knew that it had to be absolutely automatic and permanently adjusted so that no one could tamper with it.

Rids radiator of cold air

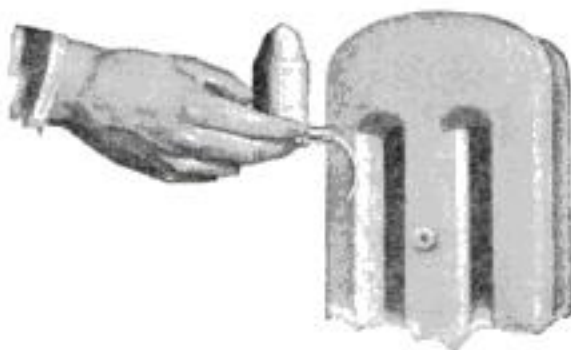
Steam, on coming into a radiator, pushes air ahead of it. Unless this air can escape, it forms a barrier beyond which the steam cannot penetrate. Thus it is possible for as much as half the radiator to be literally "choked" with cold air. No wonder steam radiators, equipped with old style air valves, won't get hot!

AIRID rids the radiator of this cold air. Inside of AIRID'S nickel-plated case, is a little float which may be said to contain the brains. Cold air, propelled by the steam, passes around this float and out through a vent-hole in the top of the valve.

SEND COUPON—attach AIRID yourself

Anyone can make a cold radiator hot by using the coupon below. AIRID can be installed by hand in two minutes without tools. Just unscrew the old valve, after turning off the steam, and insert AIRID into the same hole, screwing it tight.

Then turn on the steam, and watch AIRID work. The difference will surprise you. Your radiator becomes hot almost immediately. And the total cost is only \$1.60.



ing and sputtering.

Year after year, AIRID will go on making your radiator hot. It saves the cost of extra fuel that you might otherwise burn in trying to force the fire for more steam pressure. It saves bills for re-decorating made necessary by escaping steam and dripping water. It saves the wear and tear on nerves, caused by hiss-

Made and guaranteed by

AMERICAN RADIATOR COMPANY

Sold at all heating and plumbing shops

AIRID

AIR-VALVES

Send this coupon
with \$1.60—
TODAY

AMERICAN
RADIATOR
COMPANY
Specialties Dept.
1807 Elmwood Ave.
Buffalo, N.Y.

I am enclosing \$1.60 for an
AIRID Air Valve to make my
coldest radiator hot.

Name.....

Address.....

PEXTO RADIO PLIERS

Insure Perfect Connections



No. 32

THIS Plier, drop forged steel, full polished, will form accurately the terminals or loops on Radio Wire and Bus-bar.

One Jaw, as shown in illustration, is of double barrel construction having two diameters for forming loops to slip over 6-32 and 8-32 screws.

It is also equipped with wire cutter.



Radio Socket Wrench No. 1

For use on Radio and Electrical assembly



SET consists of handle and five interchangeable sockets, four for

Hex Nuts, sizes $1/4"$, $5/16"$, $11/32"$, $3/8"$, and one for Knurled Nuts.

Each set packed in individual box.

Write for leaflet on Worth While Tools for Radio work.

PEXTO TOOLS are carried by practically all progressive dealers.

The Peck, Stow & Wilcox Co.
Southington, Conn. U.S.A.

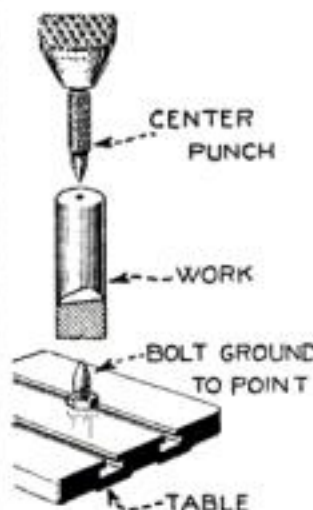
Drilling Long Holes through Rods and Small Stock

IN DRILLING holes through stock of small diameter, I find the method of drilling from both ends saves much time.

To do this on the drill press, a short bolt is ground to a point and fastened to the drill-press table. A center punch held in the drill chuck is used to bring the spindle in line with this point.

After the pieces have been centered on both ends, they are drilled halfway through and then turned over and drilled from the other end. The piece rests on the lower center and is held with a wrench or small lathe dog. The same method is also used in drilling on a lathe.—

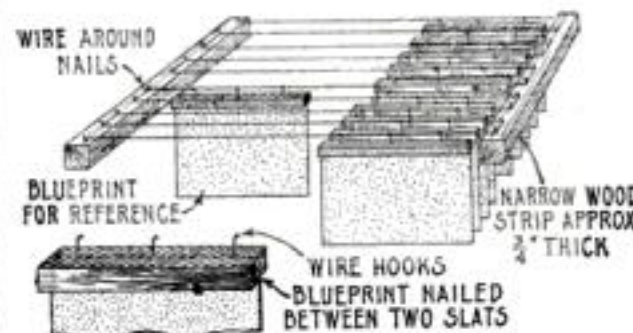
F. J. WILHELM, Cincinnati, Ohio.



How work is centered before drilling

Wire Rack Keeps Blueprints Flat and Accessible

ON CONSTRUCTION jobs where frequent reference to drawings is necessary, it is awkward to handle the blueprints if they are kept rolled up, as is the usual custom. They also are torn or misplaced easily. One contractor has found the simple arrangement shown below to



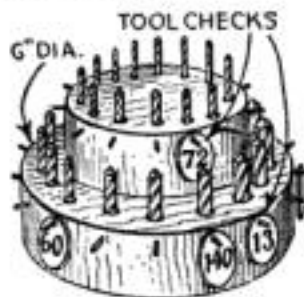
Any blueprint in the set may be pulled out for reference or removed entirely

be of great value as a time-saver and in keeping the prints in good condition.

Wire is used to form a rack by stretching it across the workroom as shown. Each print is nailed between two thin, narrow strips of wood. By means of wire hooks attached to the wooden strips, the prints are hung over the wires. Instead of the slats, patent clothespins may be used.—S. H. SAMUELS, Oakland, Calif.

Keeping Track of Small Drills in the Toolcrib

A HANDY drill block for the toolcrib, which makes it easy to keep account of the drills, can be made from a hardwood block. It is turned as shown and drilled to receive the various drills. Opposite each drill hole is placed a small nail or hook for the workman's tool check. This drill block saves both time and drills.



Clear, distinct, complete. Blurred, indistinct, hazy

Clearness vs. Indistinctness

THERE is no reason why the wonderful music now being broadcast should not come to you clear, distinct, and mellow—instead of blurred, indistinct, or crude.

N & K gives you a means of hearing broadcast music and speeches just as the musician and speaker deliver them. Nothing is lost. Every tone, high and low, is clear and natural.

The Reason for This New Clearness

In N & K Imported Phones, Loudspeaker, and Phonograph Unit practically every detail of diaphragm, sound chamber, proportions, magnet construction and winding is original and different. Everywhere has tradition been broken away from.

That is why N & K Phones are clearer, richer toned, more comfortable than head sets designed when radio meant only the sputter of a spark.

That is why the N & K Loudspeaker is different in shape, appearance and acoustic construction, and is made of a new material, *burtex*, which eliminates counter vibrations.

That is why the N & K Phonograph Unit, attached to any good phonograph, makes a loudspeaker of highest type.

N & K products are sold everywhere on a strictly money-back guarantee of satisfaction. If your regular radio dealer is not now carrying the N & K line, write us for the name of nearby N & K dealer.

Three Fascinating Folders

"The Phones the Fans Are All Talking About."

"The Loudspeaker You Have Waited For."

"How to Use Your Phonograph as a Clear, Rich-toned Radio Loudspeaker."

Send a postcard for the folder you are most interested in.

TH. GOLDSCHMIDT CORPORATION
Dept. C 12, 15 William St., New York
41 Common St., Montreal, P. Q.

N&K Imported LOUDSPEAKER TYPE W

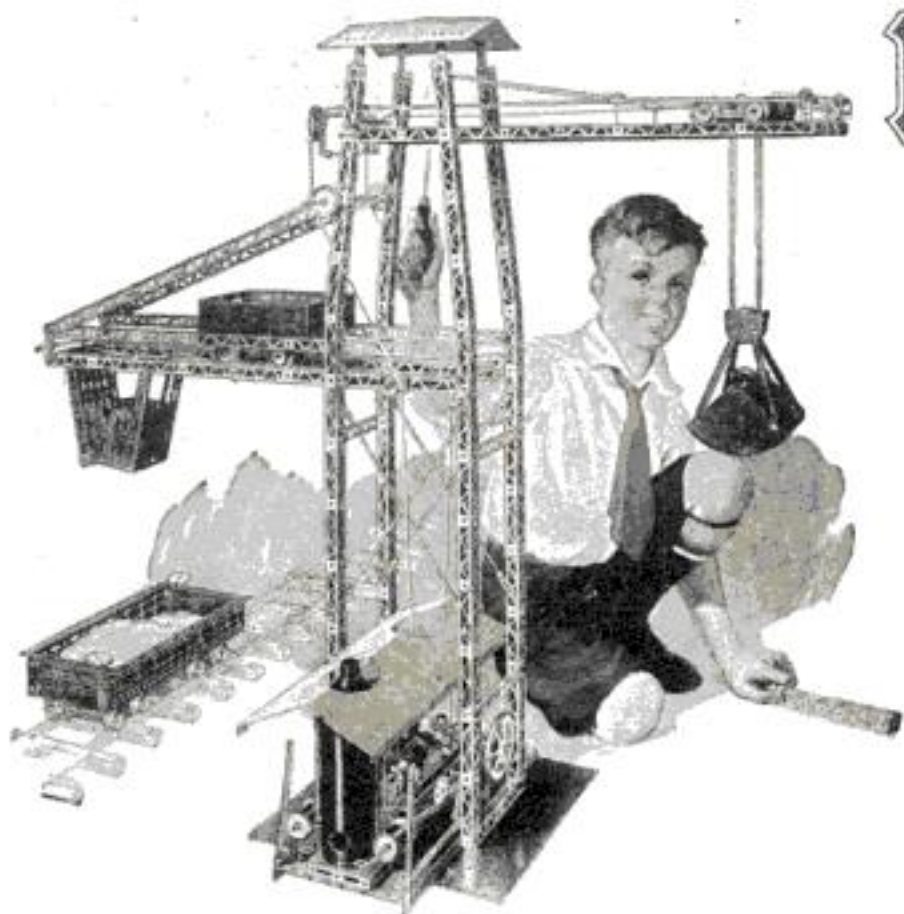
N & K Imported Loudspeaker, Type W. Its clear rich tone goes to every part of the room not just in one single direction. Economical of space. Artistic in appearance. Choice of colors. 14 in. high. \$27.50.



The greatest thrill you ever had!

THE NEW ERECTOR

"The world's greatest toy"



NEW Erector has many new features this year. Some of them are a steam shovel that digs sand and dumps its contents, a dredge bucket or clam digger; coal loader that unloads a car and loads it in a truck, boilers, to make models of steam engines and curved girders to make round models as well as rectangular ones. These parts are all additions to the standard Erector parts known for years, including the sturdy square girder which can only be built with Erector and the powerful Erector electric motor to run models.

"Five hundred toys in one"

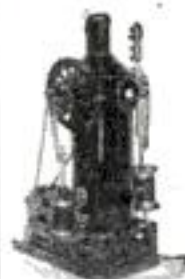
YOU never saw a construction toy like the New Erector. It is brand-new this year—the latest model with hundreds of new parts. I expect to see some wonderful results this year from the things boys have made with Erector.

Erector is made of steel with most parts nickel-plated and coated with lacquer baked on by electricity to prevent rusting.

Sit right down now and send the coupon on the bottom of the page so I can tell you about this wonderful New Erector. And don't fail to put the New Gilbert Erector at the head of your Christmas list this year.

Your friend,

A.C. Gilbert
President.



Upright engine made from New Erector



Steam shovel made from New Erector



Walking beam engine made from New Erector



Pile driver made from New Erector

New features of the 1924 New Erector
Curved Girders, Steam Shovel, Dredging Bucket, Steam Boiler, Smoke Stack, Car Trucks, Cab Top, Engine Wheels, Wagon Wheels, Propellers, Reflector, Mitre Gears, Large Gears, Crown Gears, Pulleys, Worm Gears, Drum, Eccentric Cranks, Flanged Wheels, Gear Box, Couplings, Signal Arm, Eccentric Axle, Chain, Large Steel Plates, Turret, Large Base Plates, etc.

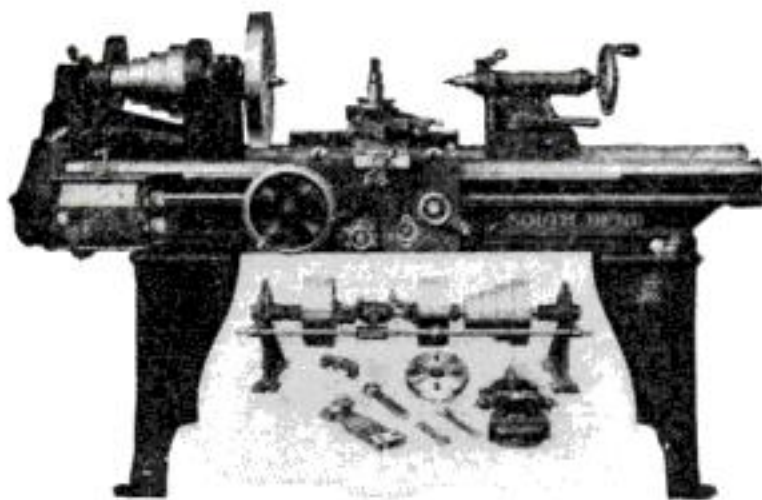


A. C. GILBERT COMPANY
342 Blatchley Ave., New Haven, Conn.

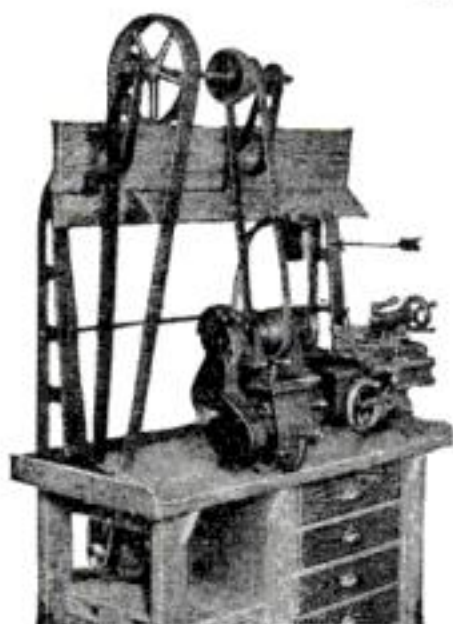
Enclosed please find 25c. for the 146 page Book (easily worth \$1.00) describing the hundreds of wonderful models made possible by New Erector, the World's Greatest Construction Toy.

Name.....

Address.....



16" x 8' South Bend Quick Change Gear Lathe
Price, \$498.00



11" x 3 1/2' Bench Lathe Unit
Complete with D. C. Motor, \$355.50

EASY PAYMENT PLAN

Our Easy Payment Plan allows you to install a South-Bend Lathe in your shop, by making one payment with the order; the balance to be paid month by month, the amount depending upon the size of the Lathe.

South Bend Lathes are made in all sizes from 9" to 24" swing, and bed lengths from 2 1/2' to 16'.

Write today for Catalog No. 82 which describes our Easy Payment Plan. Mention size lathe desired.

South Bend Lathe Works
575 East Madison Street
SOUTH BEND, IND., U. S. A.

SOUTH BEND LATHES
31,000 IN USE —

Spacing Rod Simplifies Work of Drilling Die Cores

DIE-MAKERS well know that drilling out the core of a die is a tedious operation. Unless the holes are drilled close together, the core will not come out easily. In drilling these small holes it is a common occurrence to have the drill run into the hole next to it, sometimes breaking the drill or leaving the hole partly drilled.



Drilling a die

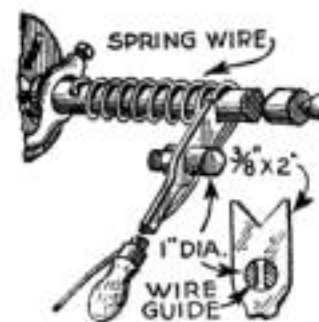
A simple kink I have been using for a number of years overcomes this difficulty and allows the holes to be drilled closely together. Take a piece of steel the size of the drill and bend it as shown

so that the short end will drop into the first hole when the long end is in the second hole.

To start with, drill the first two holes in the usual way, and after that use the bent rod. The long pin prevents the drill from running into the hole next to it. When the drilling is done in this way, the core may be removed easily by tapping it with a hammer.—CHARLES KUGLER, Philadelphia, Pa.

Spring Winding Lathe Tool

THIS spring winder is easily made and does not take up much room in a toolchest. It is simply a piece of flat steel with a V-shaped cut in one end and a 1-in. plug fastened as shown at right.



Winding a spring

The plug is provided with a hole through which the wire is threaded and another hole is drilled for the same purpose at an angle near the handle. The wooden handle may be borrowed from a file that is not in use.

Protecting Hose Lines

A FIRE hose used in a manufacturing plant for washing certain material from a pit was abraded by the edge of a manhole through which it had to be passed. This wear was obviated by slipping a section of automobile tire about 18 in. long over the hose at the point where it passed over the manhole edge.



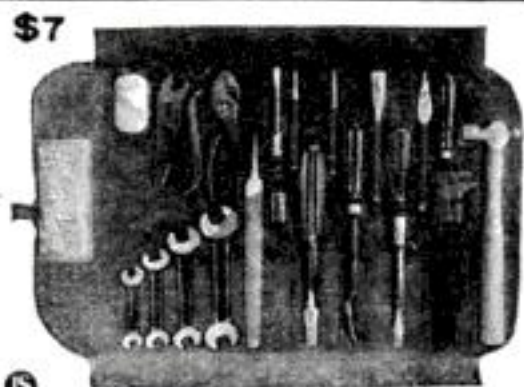
Prevents abrasion

The same idea may be used for a lawn or garden hose by placing a piece of bicycle tire at the point where the hose passes around a corner of the house or over a wall or window-sill.—S. B.

A SHOP talk on Grinding Methods, by H. L. Wheeler, will appear in an early issue.

\$25.00 in PRIZES

See top of page 10 in front of book for details.



A Kit of Twenty High Grade Tools!

WATCH Dad's eyes gleam when he opens it Christmas morning. A welcome, practical gift for any man! Twenty glistening, high grade tools, enough for most repairs and odd jobs, in a handy canvas case. This kit is made by the world's largest producers of tool kits. Specially priced at \$7.00. Carton is wrapped in fancy holiday paper.

Other popular Tool Kits, all of Vlček guaranteed quality:

No. 900 Mechanician Kit.....	\$20.00
No. 902 Motorist Kit	15.00
No. 903 Garage Kit.....	11.00
No. 908 Taxi Kit	4.00
No. 909 Little Roadster Kit...	3.00

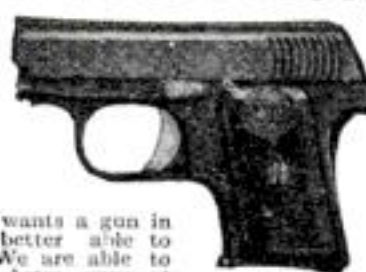
If your dealer hasn't them tell us his name, enclosing correct amount and we will see that you are supplied.

The Vlček Tool Company
3004 East 87th Street Cleveland, Ohio

EASY TO SAY VELCHEK
VLČEK TOOLS

Home Protection

with an
ASTRA
Automatic
will cost little



Nearly every man wants a gun in the house—he feels better able to protect his family. We are able to offer these Genuine Astra guns at special prices because we bought before recent tariff raises became effective. Really fine guns, beautifully finished, hard hitting. Use standard ammunition. Order direct from U. S. Importers.

\$7.75 25 cal., 7 shot ASTRA, C.O.Q. Automatic.
8.95 25 Cal., 7 shot ASTRA, Automatic
9.95 25 cal., 7 shot ASTRA, triple safety.
10.95 32 cal., 10 shot ASTRA, extra magazine.

\$16.95 "The Plainsman" Revolver

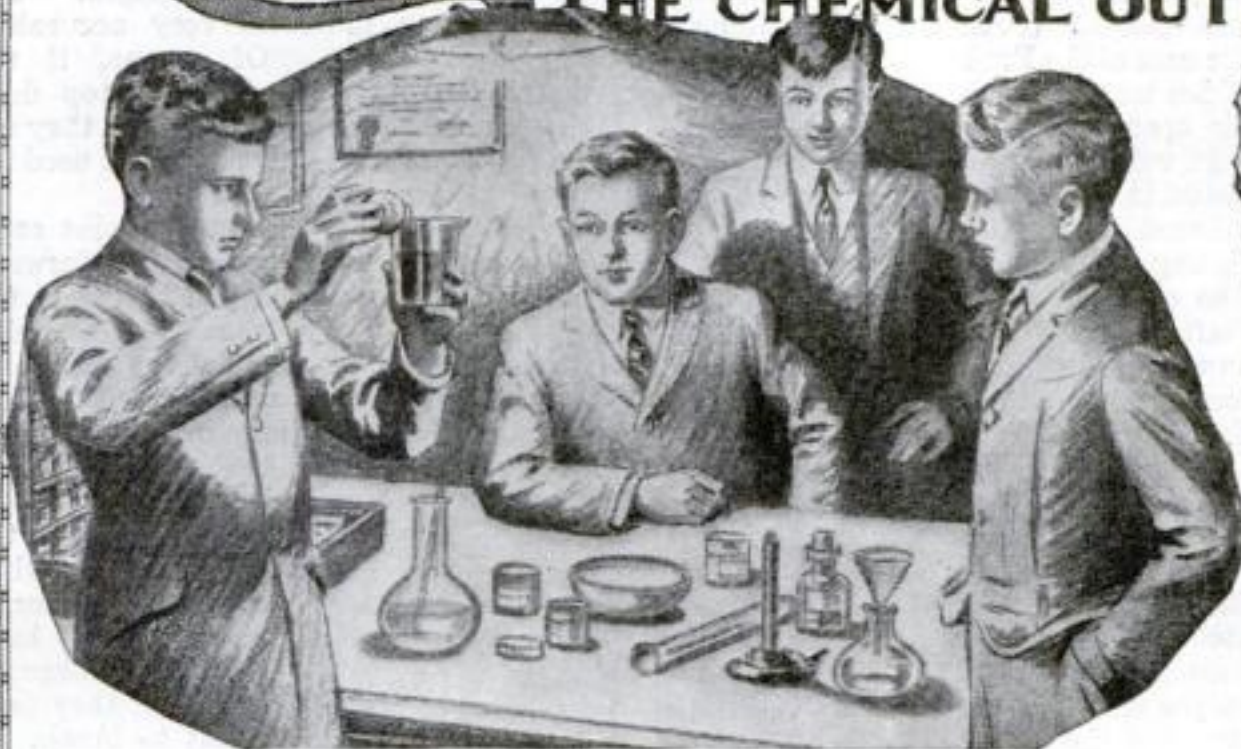


32-20 and 38 long calibre; except for difference in calibre, the same gun in weight, size and appearance. A regular he-gun, best blued steel, fully guaranteed, uses standard revolver ammunition. Only \$16.95.

Write for firearms catalogue. We guarantee perfect workmanship and material; every gun brand new; of drop forged steel throughout. Before buying any gun insist on this guarantee. Send no money unless you wish. Pay postman on delivery plus postage. Money cheerfully refunded if not fully satisfied. **ACT NOW** to get these **SPECIAL LOW PRICES. WRITE TODAY.**

CALIFORNIA TRADING COMPANY
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REGISTERED TRADE MARK CHEMCRAFT THE CHEMICAL OUTFIT



How to be a Boy Chemist!

How to Start Your Own Chemistry Club
and Work Wonderful Experiments with Your
Own Chemical Laboratory

CHEMICAL experimenting is the most fascinating fun you ever had. You can perform hundreds of interesting and practical chemical experiments that will show you how chemistry is solving the problems of science. You can test the things you eat, wear and use; make dyes, inks, soaps and other useful things; and also do lots of wonderful chemical tricks that will astonish your friends. You can have a lot of fun doing all this, and at the same time secure reliable and helpful knowledge of the most interesting science there is today—the Science of Chemistry!

You can do it all with a CHEMCRAFT outfit. You can join the Chemcraft Chemist Club, too, and be the Chief Chemist of your own Local Chapter and get other boys into your Club. You can have great times experimenting like the boy in the picture. You will also get the Club Magazine and can exchange letters and experiments with Club members everywhere. A CHEMCRAFT outfit is your introduction to the wonders of chemistry—it makes you a Boy Chemist!

Five Fine CHEMCRAFT Outfits

No. 0-75c, No. 1-\$1.50, No. 2-\$2.50, No. 3-\$5.00, No. 4-\$10.00

No. 3 Outfit shown below.

(West of Denver, Colo., and outside the United States, these prices are 10% higher.)

Each outfit is a complete chemical laboratory for boys, and contains an assortment of harmless, non-poisonous and non-explosive chemicals, all necessary apparatus and a Manual of Instruction. Liberal quantities of all chemicals are provided so each experiment and trick can be repeated many times. CHEMCRAFT is the original, most complete and most reliable chemical outfit; originated by chemists, used in schools and colleges, and endorsed by teachers and professors.

Look for CHEMCRAFT in any store where good toys are sold. Be sure you see the name on the box. If you cannot get the outfit you want, we will send one from the factory, postpaid, upon receipt of price as above.

THE PORTER CHEMICAL COMPANY

Porter Products Put Science at Your Service.

127 Washington St., Hagerstown, Md.



The Chemcraft Chemist

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THE CHEMCRAFT CHEMIST CLUB

Devoted to the Promotion of
Chemical Knowledge Among Club Members and Local Chemists.

Published by
THE PORTER CHEMICAL CO.
HAGERSTOWN, MARYLAND

The Mystery of the Bronson Fire

A Story for Boys

by

Nella L. Remie

WELL, I guess she's all right now," said Bob Bronson, as he sat up straight after a careful examination of a peculiar-looking apparatus which lay on the work-bench before him. "Just hand me that cap, Pete, and we'll put it on. Gee, I'll bet she'll work fine now!" he concluded, with a confident shake of his head.

His pal, Pete Henderson, passed the cap across the bench and Bob screwed it on the end of the apparatus.

"Gosh," exclaimed Pete, as he watched the operation, "we've been foolin' with the old thing long enough. I only hope it works like you think it will. Let's go out in the back lot now and see what it will do."

"Not tonight," objected Bob, "it's too dark, and we might break it. We'll have a big demonstration tomorrow afternoon, out behind our garage. Be sure to come around."

"All right," agreed Pete. "I'll be here about three o'clock. Have to go home now. So long!"

After Pete's departure, Bob cleaned up his work-bench, put his things away, and with his newly completed invention under his arm, trudged upstairs to his room, a very tired, yet extremely happy boy. After carefully hiding his invention in the closet, he undressed and jumped into bed. He was sound asleep when his mother looked in at the door half an hour later.

CHAPTER TWO

Bob Bronson was one of those fellows who is always tinkering with something. When he wasn't building a wagon, he was making a new kind of hob-sled, or doing something else which served as an outlet for his abundance of youthful energy.

Pete Henderson was his companion in his many enterprises. They had tried about everything possible for a couple of sixteen-year-old boys, from an unsuccessful attempt at being private detectives, to a very successful season as lemonade merchants selling to passing motorists along the State Road.

But now they were busy on a new idea. This idea got its start when Bob's Uncle Ben gave him a chemical laboratory as a birthday present, a few weeks before. They had added to the original equipment and had set up a combined shop and laboratory in one corner of Bob's cellar. And there they had mustered the wonders of Chemistry in a short time.

Then Bob's liking for inventing new things had crept up, and they turned their attention to the invention of the apparatus upon which they had just put the finishing touches. They were both sworn to absolute secrecy; no one but they knew what it was, and they guarded their secret well and successfully.

They had been working on it for a long time, giving up in despair at times, but always coming back to it with renewed energy. They had been through many failures, and were now they had finished their work and were impatient for the final trial. Though Bob did not know at that time, and it was several years before

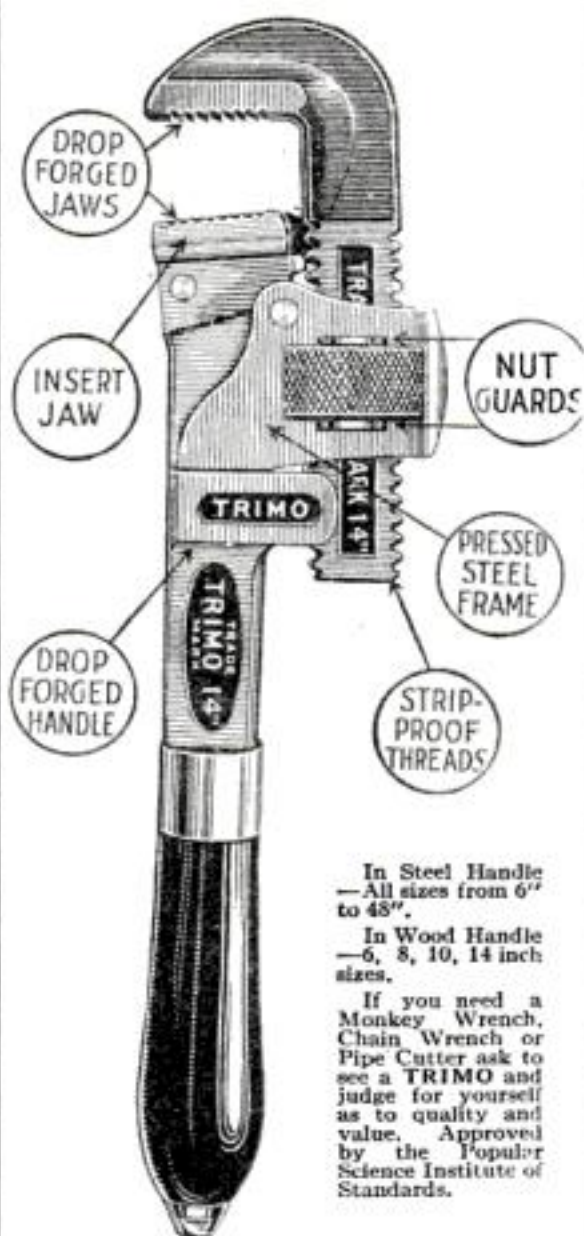
THE PORTER CHEMICAL COMPANY,
127 Washington St., Hagerstown, Md.

Please send me the rest of the story about
Bob Bronson.

Name.....

Address.....

You Need This All-Purpose Wrench



In Steel Handle
—All sizes from 6" to 48"
In Wood Handle
—6, 8, 10, 14 inch
sizes.

If you need a
Monkey Wrench,
Chain Wrench or
Pipe Cutter ask to
see a TRIMO and
judge for yourself
as to quality and
value. Approved
by the Popular
Science Institute of
Standards.

Here's one tool that every man who fixes things ought to have in his personal kit. It's as necessary 'round the house, car, or farm as scissors to a barber.

Be sure you get a TRIMO. Its several superior features of design, indicated in the above illustration, are your assurance that it will tackle the toughest jobs and do them better and easier than any other wrench. And it's by far the cheapest wrench you can buy in the long run because insert jaw as well as all other parts are replaceable when worn and can be obtained at small cost at any hardware store.

The pipe wrench approved by the Popular Science Institute of Standards—a wrench that you'll be proud to own. Your dealer has it in all sizes. Insist on TRIMO.

Trimont Mfg. Co.
Roxbury, Mass.

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7349

TRIMO

Timing an Auto Ignition System

IGNITION timing and engine timing, as mentioned last month, are two distinct operations. Ignition timing refers to the proper setting of the contact-breaker arrangement (commutator or timer in the case of the Ford), while engine timing, which was discussed last month, refers to the opening and closing of the valves.

In valve timing, work is done with the piston in cylinder No. 1 on the end of the exhaust stroke, the exhaust valve just closing and the intake valve just opening. One complete turn of the engine crankshaft and flywheel will bring piston No. 1 on top dead center again; but this is the compression stroke. It is the one used for timing the spark to the engine.

The reader is familiar with the four-stroke cycle of the four-cycle engine. First comes intake on the first down stroke of the piston; the gas drawn in then is compressed on the second or up stroke of the piston. At that point (upper dead center compression stroke) the spark occurs and the charge is fired.

The third stroke is the power stroke in which the piston is driven down, and the fourth stroke is the one in which the up-coming piston drives the burned gases before it. Thus we have intake, compression, power, exhaust, in a continuous chain of cycles of four strokes each. These things are mentioned here because it is so easy for the owner to get into the habit of thinking that all that is necessary is to get piston No. 1 on top dead center and then set the ignition to it. Piston No. 1 must be on top dead center, but on the compression and not on the exhaust stroke.

In timing ignition, the motorist first should turn the engine over until at the end of the exhaust stroke the exhaust valve closes and the intake valve starts to open. The operation of the valves is watched by noting the action of the valve lifters (remove the cover plate if necessary). One full turn of the crankshaft then will bring the piston to the end of the compression stroke and the engine should be stopped with the piston on exact top dead center.

If the cylinder head is off, this is easy, because the movement of the piston is visible. If the cylinder head is not off the engine, the spark plug should be removed and a wire inserted to rest on the piston top. If the spark plug is set to one side

By Ray F. Kuns
Principal, Automotive Trades
School, Cincinnati, Ohio

of the piston, make an indicator such as the one illustrated and insert it in the spark-plug hole in such a way that the stick is held in an upright position and rigid. The pointer then indicates very accurately top dead center. Of course, if the markings on the flywheel for top dead center are known to be right and they are readily accessible, they should be used for top dead center location.

With this most important point carefully located, turn the engine forward until the piston has dropped 1/64 in. in the cylinder, or the flywheel has traveled through 5 degrees. Allow the engine to rest in that position and remove the distributor cap. Set the manual control on the steering gear so that the lever is in spark-retarded position.

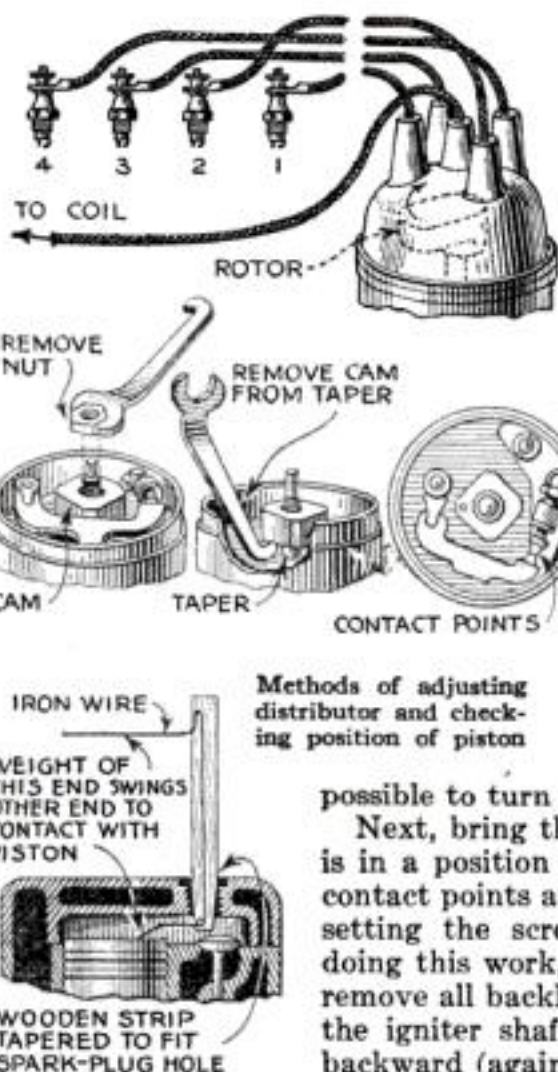
Note whether the contact points within the distributor or igniter head have opened or broken, or whether they are about to break. If they are found to be just on the point of opening or ready to open, the setting of the cam should not be changed. If they are not close to their proper position, it will be necessary to loosen the little screw in the center of the igniter shaft and raise the cam that operates the breaker arm off the tapered end of the shaft so that it is possible to turn it freely.

Next, bring this cam forward until it is in a position just about to open the contact points and lock it in position by setting the screw back snug. While doing this work, it will be necessary to remove all backlash or lost motion from the igniter shaft by turning the shaft backward (against the direction of rotation) and maintain it in that position until the cam is locked.

Another point where trouble may be experienced by the car owner is that in getting the igniter to break properly, it is adjusted so that the high-tension spark or jump spark is led to the wrong cylinder. To avoid this mistake, it is always worth while to maintain the settings just described until the rotor is replaced in the igniter and the distributor cap held in place, when it may be noted whether the outer end of the rotor, with its brass or carbon brush, is under or in contact with the copper segment or point that has a wire running to cylinder No. 1.

If this is correct, the timing is complete and accurate, unless other wires are off the head, in which case it will be necessary to run the successive wires from the distributor head to the successive cylinders of the engine in their firing order.

(Continued on page 128)



The Greater NEUTRODYNE EAGLE

Balanced Receiver



"My Choice this Christmas"

**Model B 5-Tubes
Price \$175**

The Guarantee that accompanies every EAGLE Receiver fully protects you.



**MODEL B5
A New Eagle Artistic
Console Cabinet
Price \$100**

An artistic Console cabinet, for the EAGLE, in American Walnut or Mahogany, with fuse-proof compartments for battery and charger.

Licensed by Independent Radio Manufacturers, Inc., under Hazeltine Patent Nos. 1,450,080, dated March 27, 1923, and 1,489,226, dated April 1, 1924. Other patents pending.

Write for Literature

EAGLE RADIO CO.



26 Boyden Place
NEWARK, N. J.

Dear Mother:

Merry Christmas! You see Santa Claus did remember what you said about wishing you had a radio set like ours, didn't he?

In fact, Mother, this is even a better Eagle Receiver. It's what is known as the New Model B Eagle. Your Eagle is even simpler to operate than ours. All you have to do to locate the different stations is turn the dials to certain numbers, which are always the same.

Another thing: you don't have to bother with plugs any more. You switch on the different stages and batteries just by a turn of the center knob, which operates a multiple (filament control) switch. Your Eagle has a number of important refinements - instruments which are exclusive Eagle features, among them a ball-bearing die-cast condenser and a new design rheostat.

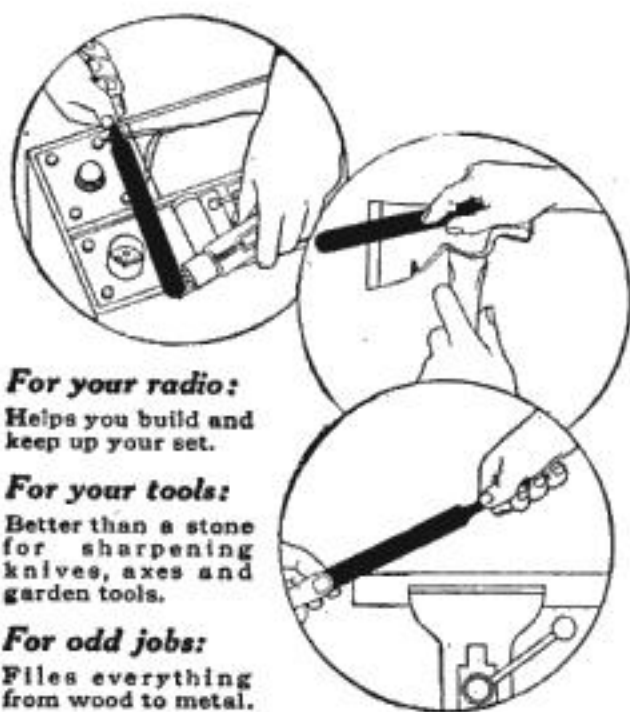
Excuse me, Mother, I didn't mean to cover so much good paper with my "radio ravings" but I can't help feeling happy about this new Eagle coming out just in time to send to you for Christmas.

I wanted to be sure I was getting the best receiver, so I tried out all the leading makes. But none of them could compare with the Eagle Model B for real simplicity, quality of reception and appearance. Just one other thing, Mother. You needn't worry should anything happen to your Eagle as it's absolutely guaranteed.

Now I'll sign off, Mother. Let's hear how you make out with your Eagle. Suppose you'll be as much of a bug as I am, in a month or so.

Loveingly, Bob

©



For your radio:
Helps you build and keep up your set.

For your tools:
Better than a stone for sharpening knives, axes and garden tools.

For odd jobs:
Files everything from wood to metal.

With this file you can do any job

ANY man who likes to work with tools needs this new and better file—The Plumb All-Work File.

The handle, forged as part of the file, fits your hand, gives you perfect control of the stroke and makes filing easy.

No handle to buy—no handle to lose—no handle to turn in your hand and ruin your work and temper.

The sheath protects the teeth from rust or injury, fits your pocket and is fine for your tool box.

File is 10 inches long, 3/4 inch wide—just the size that is most useful.

PLUMB
DOUBLE-LIFE

All-Work* File with sheath

(*Trade Mark Reg. U. S. Patent Office)

It has two faces; double cut (coarse) on one side for fast work, single cut (fine) on other side for a smooth finish.

Two files in one, with forged handle and sheath.

For your pocket, your tool kit, your shop and your car.

35¢ at your dealer's or by mail
(40¢ West of Rocky Mts.)

Don't put off getting this file, just the one you need for every kind of work.

The better hardware merchants now have the Plumb All-Work File. It's a pleasure to supply you if your dealer can't. Just send the price (stamps will do) and the All-Work File will come to you by the next mail.

FAYETTE R. PLUMB, Inc.
4812 James Street Philadelphia



Washing Photographic Prints

WASHING photographic prints so that all of the "hypo" or fixing solution is rinsed away, presents a problem to many not possessed of a print-washer. A print-washer can be made cheaply, however, by placing a specially prepared hose on the water tap in the lavatory.

Obtain a 5-in. length of rubber hose, costing 5 cents, at the drug-store. Fit a cork in one end and make a narrow incision in one side of the hose 1 1/2 in. above the cork, as shown.



How the rubber tube is slit and adjusted

The hose is slipped over the water faucet in the lavatory bowl, which should be three-quarters full of water. The pressure of the water flowing out of the incision in the hose will cause all prints placed in the water to rotate rapidly. The waste water overflows down the drainpipe.

Prints can be washed in an average of 15 minutes, with a saving of a half hour over other methods.—K. B. M.

Timing an Ignition System

(Continued from page 126)

The beginner sometimes has the idea that the cylinders starting from the first one fire in order. This is never true. A four-cylinder engine may fire 1-3-4-2, or 1-2-4-3, but never 1-2-3-4. Sixes may have a number of firing orders, and this must be learned on occasion. It is usually stamped clearly on the engine.

There are many variations of the above methods, especially with reference to the construction of the igniter. These cannot be given here, but the underlying principle is the same. The spark, when the manual control is in retarded position, must be made to occur (by properly setting the breaker) at a point from 5 to 10 degrees past top dead center, compression stroke, and the spark thus obtained must be led from the distributor head to the proper cylinder, and other and succeeding sparks to their proper cylinders in turn.

Coming Workshop Articles

ON THE Home Workshop schedule for early publication are: Steering Dangers and How to Avoid Them; Circular Picture-Frame; Crafts Hall Table; When Your Faucets Leak; Ornamental Metal Work with Hammer and Shears; Building an Aerial Mast that Requires no Guy Wires; Old Pipe Furnace Converted into an Efficient Pipeless Heater; Recaning Chairs; and Wash Boiler Aids in Building Sporty Racing Sled; How to Construct Attractive Bird Houses; Turning Off a Gas Water-Heater from a Distance, and How to Cut an Arched Opening in a Partition.

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A 24-Volt "B" Storage Battery positively given FREE with each purchase of a WORLD "A" Storage Battery. The WORLD Battery is famous for its guaranteed quality and service. Backed by years of Successful Manufacture and Thousands of Satisfied Users. You save 50%.

Prices That Save and Satisfy

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6-Volt, 11 Plate	\$12.25	6-Volt, 100 Amps.	12.50
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proves satisfactory World performance. Mail this ad with your name and address—we will ship battery day order is received; and give you your choice of "B" or "A" Storage Battery, handsome nickel finish Auto Spotlite, FREE. Write TODAY.

WORLD BATTERY COMPANY
1219 So. Wabash Ave. Dept. 7 CHICAGO, ILL.

This FREE "B" Storage Battery takes the place of dry cell "B" batteries. Can be recharged and will last indefinitely. To be sold retail for \$6.00. It is the only battery of its kind equipped with solid rubber case—and insurance against acid and leakage. Take advantage of this remarkable introductory offer NOW. (To those who prefer it, we will send FREE a handsome nickel finish Auto Spotlite, instead of the "B" battery. Be sure to specify which is wanted.)

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By CHARLES B. HAYWARD. A practical handbook covering the design, construction and operation of aeroplanes and gliders. 150 pages. Price \$1.60.
Popular Science Monthly, 250 4th Avenue. :: New York

The Innovation of the Year

ONE-PIECE STATOR

(Pat. Applied for)

AN EXCLUSIVE and UNIQUE FEATURE; value immediately recognized by entire radio world. Eliminates broken contacts, soldered joints, leakage and resistance. Found in types 3 (plain) and 4 (all vernier), CELORON END PLATES; Types 5 (plain) and 6 (all-vernier). **LOW LOSS—METAL END PLATES.**

CS and CV Low Price Types Always in Stock

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for Machinists, Carpenters and Tool Makers; none better; thirty styles. Quartered oak and metal covered. Ask for booklet.

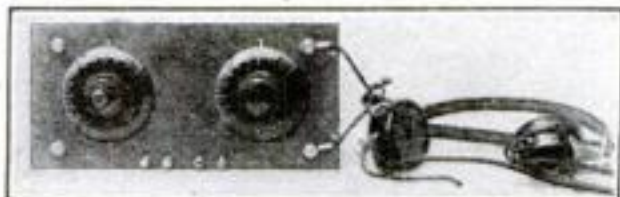
"Built for Service"

The Pilliod Lumber Co., Swanton, Ohio

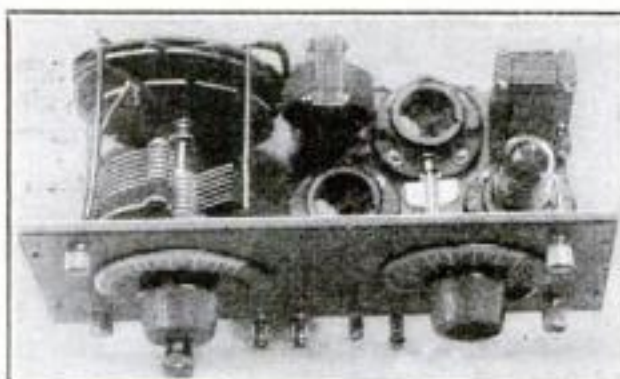
Unique Tuning Unit Saves Space in Radio Set

By Kenneth M. Swezey

OCCASIONALLY a radio receiving set is wanted that is especially compact or one that has adjustments simple enough for a child to manipulate. As there is little latitude for crowding together the detector or amplifier sections, and these parts require few adjustments, the com-



Compact three-tube set using special tuner

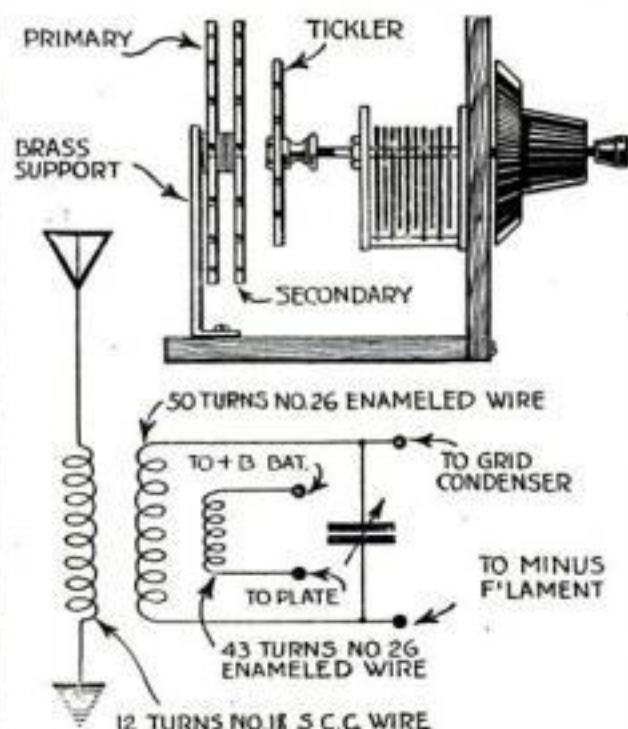


Top view, showing tuning condenser and coils

pactness and simplicity must be incorporated in the tuning unit.

The tuning apparatus illustrated fills both requirements nicely, is inexpensive, and is easily constructed.

First, obtain a variable condenser having a maximum capacity of from .00025 to .0005 mfd. It should be of the type having a single-plate Vernier attachment in the rear that is operated by varying a small knob in the center of the dial. From this the Vernier plates should be removed and in place of the original shaft a longer



Details and wiring diagram of special tuner

one of the same diameter should be provided. This should project back about $1\frac{1}{4}$ in. past the rear bearing.

Thread about $\frac{1}{2}$ in. of each end of this shaft, one end for the Vernier knob and the other for a couple of nuts and a spider-web form.

The coil that goes on this shaft is the tickler. It should be wound on a spider-

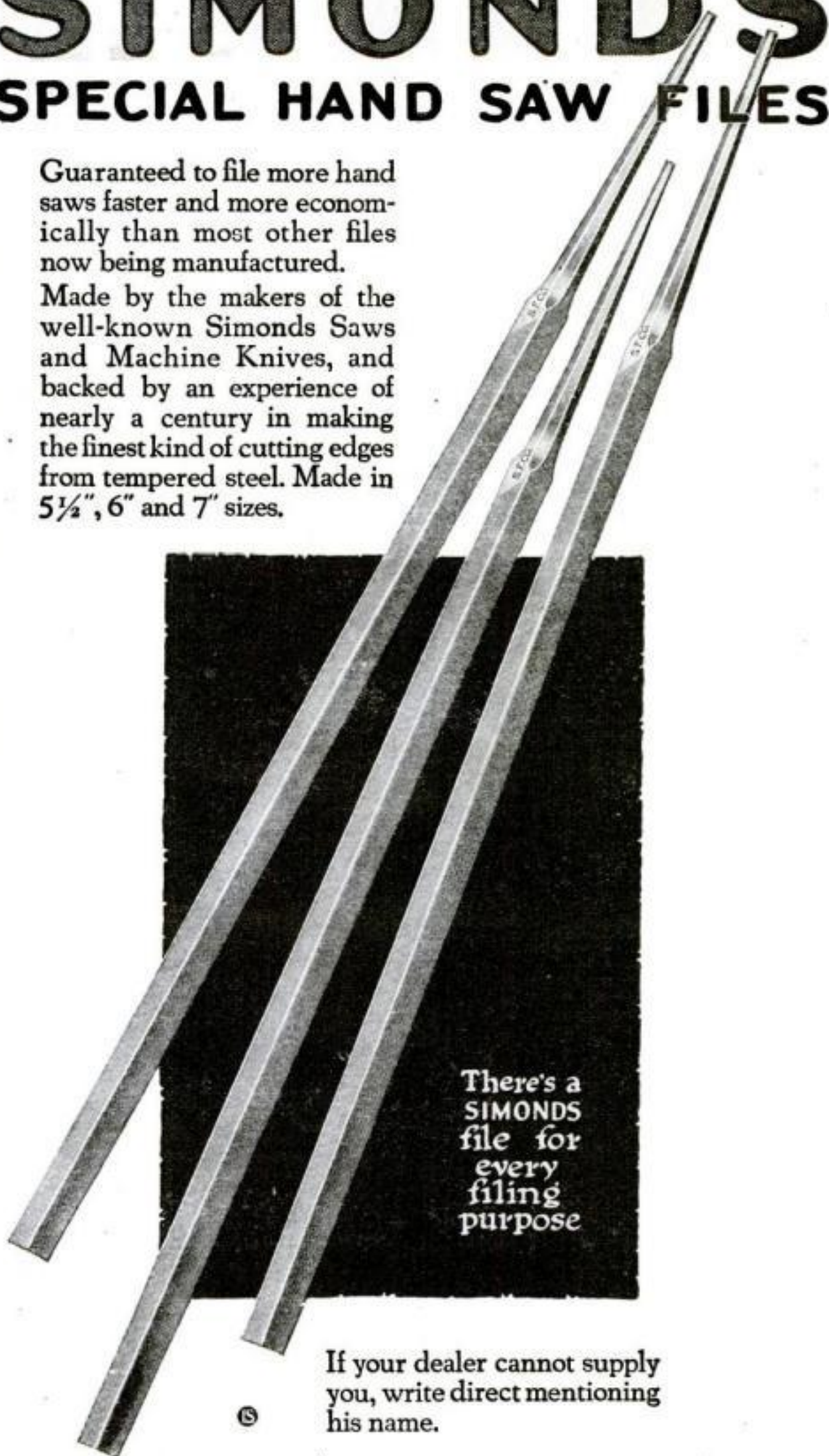
(Continued on page 130)

SIMONDS

SPECIAL HAND SAW FILES

Guaranteed to file more hand saws faster and more economically than most other files now being manufactured.

Made by the makers of the well-known Simonds Saws and Machine Knives, and backed by an experience of nearly a century in making the finest kind of cutting edges from tempered steel. Made in $5\frac{1}{2}$ ", 6" and 7" sizes.



There's a
SIMONDS
file for
every
filing
purpose

If your dealer cannot supply you, write direct mentioning his name.

SIMONDS SAW AND STEEL COMPANY
"The Saw Makers" Fitchburg, Mass. Established 1832
Branch Offices in Principal Cities



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Made Only to the Friends of
POPULAR SCIENCE MONTHLY

WOULD it not be grand to have some good friend tell you that your Christmas presents this year would cost you nothing? That you could go "as far as you liked" in your Christmas purchases with no worry whatever about paying the bills?

\$5 **For You**
*For Giving a
little time to*
**POPULAR SCIENCE
MONTHLY**

If you are one of the many readers of POPULAR SCIENCE MONTHLY who find this magazine interesting and useful, who feel that they could not do without it, then we know that you will be glad to tell a few friends that you like "Popular Science" and that you want them to read it too.

We have a plan we should like to tell you about, a plan by which we shall be glad to pay you Five Dollars, if you will undertake a few hours work for us.

And if you can devote more than a few hours to our plan, you can make many times the first five dollars.

Won't you write your address on the coupon below and send it to us *today*? We will explain the plan to you by return mail.

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Please tell me about your plan by which I can earn \$5.00.

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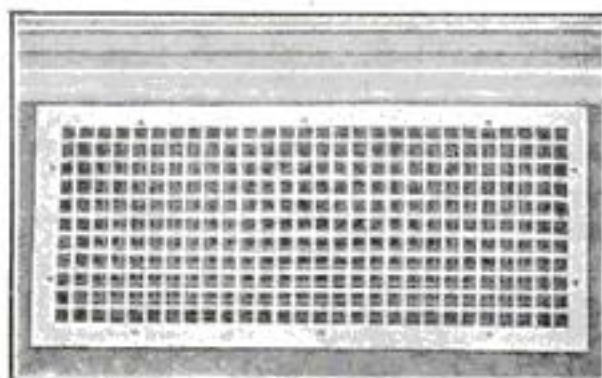
Address _____

Occupation _____

Wall Grille near Ceiling Aids Hot-Air Circulation

THE home builder who has located the register for his pipeless furnace in a central hall close to the living-room door often finds the living-room to be the coldest part of the bungalow.

The heat rises rapidly to the ceiling into a "pocket" higher than the door opening. Then the heated air floats toward the back of the hall and drifts



A grille between two rooms improves the heating efficiency of a pipeless furnace system

through open doors where no strong current of rising hot air prevents its entrance.

This difficulty may be overcome by installing an ornamental grille of heavy tin enameled to match the woodwork. It is set in the wall between the living-room and hall as near the ceiling as possible.—A. MAY HOLADAY, San José, Calif.

Unique Tuning Unit

(Continued from page 129)

web form 3 in. in diameter—43 turns of No. 26 s.c.c. or enameled wire. A nut on the condenser side and a very thin nut on the other side will hold the coil securely to the shaft. Instead of the former rotary motion of the vernier, the new shaft moves in and out.

When this coil is in place, the condenser and tickler unit may be mounted on a panel in the usual manner.

Next come the primary and secondary coils. These are both wound on 3 1/4- or 3 1/2-in. spider-web forms. The primary coil consists of 12 turns of No. 18 s.c.c. wire and the secondary, of 50 turns of No. 26 enameled wire.

The mounting for these two coils is in the form of a bracket made as shown from a strip of brass. A machine screw passes through them, with a nut between to separate them about 1/4 in.

The bracket should be fastened to the sub-base at a point that allows the tickler coil, at its full extension, to come as close as possible to the secondary coil without actually touching. The secondary coil faces toward the condenser, and the primary toward the rear of the base.

In operation this arrangement is simplicity itself. The primary is aperiodic and responds equally well over the ordinary band of broadcast wave lengths. The secondary is tuned entirely by the variable condenser. When the tuning has been accomplished, the proper amount of regeneration may be obtained by moving the tickler coil in and out. Finally, a slight readjustment is made of the secondary condenser and the tickler.

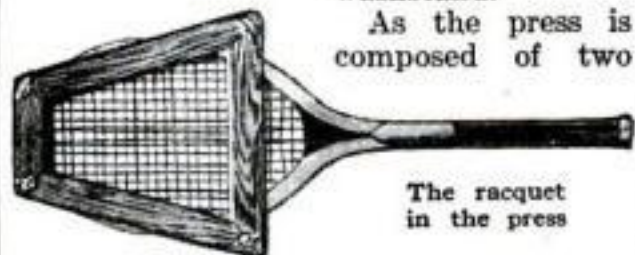
The unit may be connected with any vacuum-tube detector and audio-frequency amplifier.

How to Construct a Press for Your Tennis Racquet

WINTER evenings provide an opportunity for making and repairing sporting equipment and doing the odd jobs the outdoor man or boy is not so apt to undertake at other times of the year. One useful piece of equipment that may be made is a tennis press.

The type illustrated is a modification of the usual square press. Three of the sides are 11 in. long; the other is 5½ in. Any light-weight wood 1¼ in. wide by ¾ in. thick will do. The one shown was made from the towel-rack of an old ash washstand.

As the press is composed of two



The racquet in the press

frames, one for each side of the racquet, cut six pieces 11½ in. long and two 5½ in. long. Next, construct a small miter-box of three pieces of wood; make one angle sawcut of 38 and another of 53 degrees, using a protractor for the purpose.

The 38-degree joints are at the lower ends in the illustration and the 53-degree joints at the top. Assemble the frames on the bench, and, with the aid of a vise, make a sawcut in the edge of the wood at each corner so that the slit shows 1¼ in. long. Keys of veneer or pieces cut from wood from fruit baskets are inserted in the slits. See that they fit snugly.



Method of using corner frame keys

Spread glue evenly at the joints, and insert the bits of thin wood into the saw cuts. Work quickly if you are using hot glue.

Allow several hours for the glue to set. Trim off surplus wood, and round corners neatly. Plane lightly if there are any inequalities in the fit of the joints. Finish with sandpaper.

Bore holes in each corner to accommodate 3-in. bolts of ¼-in. diameter. Use bolts with round heads and wingnuts that screw down on washers to save the wood. —AUSTIN G. TRIBUTE, Toronto, Can.

Merry-Go-Round Furnishes Fun

(Continued from page 96)

screw. The pole should be left overnight so that it will be frozen in solidly.

Mount a 12-ft.-long plank on top of the wheel and fasten a rope at each end to hold the seats. These are built of 2 by 4 in. by 12 ft. pieces held about 1 ft. apart by four short pieces arranged as shown. Run the ends of the ropes through holes bored near the ends of each seat and knot on the under side.

A little axle grease for the wheel bearing will help, and the friction can be reduced further by the use of a large iron washer between wheel hub and post top.

While the device is intended for turning, it can be made to oscillate if the center cleats are omitted and the seat stringers set 2 or 3 ft. apart.



I'm not a
mind reader
but I have
a suspicion
that someone
in your home
would like

a Corona for Christmas!

CORONA is such a satisfactory gift! To the novice at typewriting it brings a new and fascinating accomplishment—while the experienced typist finds it the most convenient, practical, sturdy writing machine the world has ever seen.

Talk Corona over with your family today. See if some face (perhaps your own!) doesn't light up at the thought of a Corona for Christmas!

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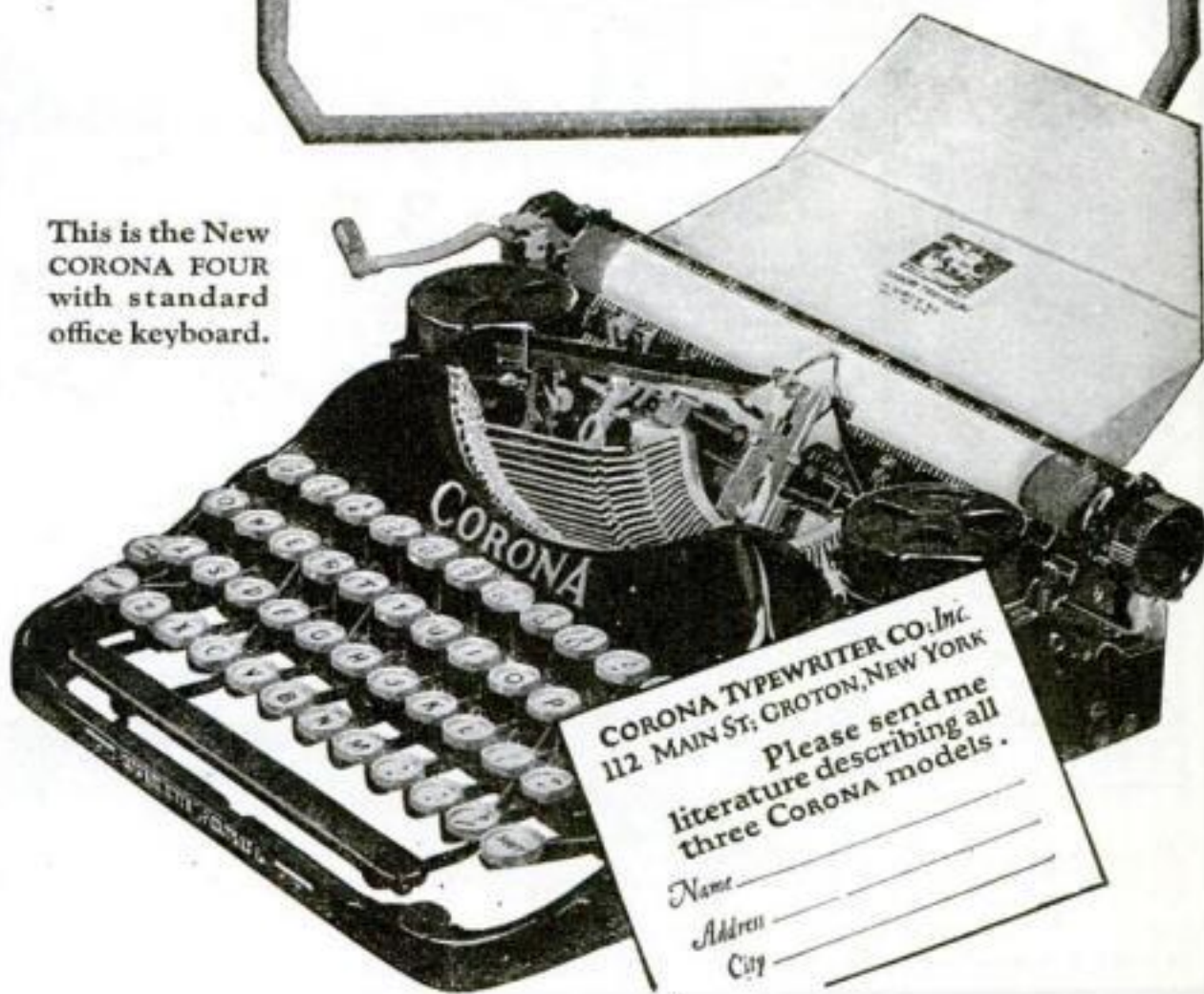
The New CORONA FOUR with standard office keyboard, \$60.

XC CORONA, 90 character machine for foreign language or technical writing, \$55.

CORONA THREE, the original Personal Writing Machine, \$50.

There's a Corona dealer near you.

This is the New
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with standard
office keyboard.



CORONA TYPEWRITER CO. Inc.
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Please send me
literature describing all
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Why it is Better

Original three point suspension assuring perfect alignment which prevents buckling or short circuiting of plates and affords 7/16 inch air dielectric between condenser head and panel. Template furnished with each condenser



Over-size, hard brass jam nut affording a positive lock for rotor plates.

Special hexagon bearing lock nut.

Full quarter inch circular bakelite heads die-tapped and jig centered.

Exclusive female cone bearing, machine centered and provided with "star" spring to compensate for wear.

Federal 11 plate and 21 plate have minimum capacities never exceeding 10 micro-micro-farads while the minimum capacity of the 43 plate condenser is always less than 10 micro-micro-farads.

This is the rotor bearing with extra long brass bushing, machine centered, true to 1/1000 of an inch.

Both rotor and stator plates are of aluminum of practically constant surface resistance, each held rigidly by large draw-bolts thus eliminating the use of solder and its inherent resistance.

All burrs are automatically removed from plates during a pack annealing process employed to straighten plates after punching.

Plates are micrometer calipered; positively insuring true spacing.

Machine ground male cone bearing. Self centering.

Special jam nut and rotor terminal

"Star" spring of special tempered steel to automatically correct alignment and maintain positive electrical contact.

LOOK at this illustration—see for yourself the eleven distinctive features in the construction of the Federal Condenser. Every feature is a distinct point of superiority—essential to clear, sharp tuning and clear reception.

To get the outstanding advantages of

Federal Tone and Selectivity in your pet hook-up insist on Federal Parts.

There are over 130 Federal Standard Radio Parts bearing the Federal iron-clad performance guarantee. Use them—for your own protection and enjoyment.

FEDERAL TELEPHONE AND TELEGRAPH CO.

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Federal

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Home Workshop Chemistry

Simple Formulas that Will Save Time and Money



MUCILAGE and paste are so constantly used that one quite often finds the supply has run out just when it is most needed. It is a simple matter, however, to make up a jar of adhesive from materials that are or should be in the chemical cabinet of every reader of this column.

Gum tragacanth is excellent for making mucilage, as it has great adhesive properties and also is cheap. One ounce of this gum is sufficient to make a quart or more, depending upon the consistency of the paste desired.

Place a teaspoon of powdered gum in a large bottle. Add $\frac{1}{2}$ cup denatured alcohol and mix thoroughly. Care should be taken to break up all lumps. The entire gum should be in a very fine powder. Then add $\frac{1}{2}$ cup water and stir. A thick paste results. If too thick, thin with cold water.



A colored ink for marking directly on bottles, glassware, or windows can be made from shellac, alcohol, borax, and a dye

Another mucilage can be made by dissolving 1 teaspoon of gum arabic in $\frac{1}{2}$ cup of water, adding 5 or 6 drops of glycerine.

If desired, these gums may be mixed, but there is very little advantage over the gums used individually and it is not recommended.

The above pastes are acid free and therefore are adapted for mounting photographic prints, for which a glue free from chemicals must be employed. This does not mean that this paste is restricted for this purpose; it can be used wherever paste of any character is to be employed.

At times it becomes necessary to write on glass, especially on bottles kept in the home workshop. This is accomplished most conveniently with a specially prepared ink. Dissolve a rounded teaspoonful of shellac in 7 teaspoons of alcohol. Then dissolve in another glass 1 teaspoon borax in 8 teaspoons of water. When both have dissolved, pour the borax solution carefully into the alcoholic shellac, stirring continually. This darkens the shellac solution.

Now add any dye to color the liquid,

(Continued on page 133)

"BE THE LIFE OF THE PARTY"

Play a Saw

With Our Free Course of Instruction You Can —Play in 3 Days—

Just think of it! In 3 days, without any musical ability—without knowing one note from another—you can quickly play such songs as "Long, Long Trail," "Till We Meet Again"—all the old and new-time favorites—the day Saw arrives.

Yes, indeed, within 3 days you will be playing all the popular songs, hymns and classical music you and your friends love. The sweet, mellow, pleasing tone from our Musical Saws you have heard in Vanderbilt, over the radio and on Phonograph Records. Now over 10,000 men, women, boys and girls are playing our Musical Saws at parties, dances, lodges, church entertainments, everywhere. Over 100 famous dance orchestras are using our Saws.

Play or No Pay

We guarantee that you can play our Musical Saw within 3 days by following our simple, easy course of instruction. The Musical Saw is guaranteed to be perfect and satisfactory in every way. If not, return in 3 days and your money will be refunded under our Bank Guarantee. The Musical Saw is specially tempered by a Special Process, to produce soft, sweet, mellow tones, obtainable from no other source under our specific guarantee.

This is your opportunity to quickly become a master Saw Musician and entertainer—the "Center of Attraction" and in demand, in your neighborhood, your own town, in cities everywhere.

Send No Money

Simply send coupon today. We will send you our special Tempered Musical Saw, Special Soft Musical Hammer and Free Course of Instruction by return mail. The complete outfit is only \$4.85 C. O. D. Pay on arrival \$4.85, plus a few cents postage. Former price \$13.50. Nothing like this ever offered before. This reduction due to great demand and low producing cost.

The musical saw is one of the greatest bargains ever offered in music. Be the one to furnish the "Big Surprise" at your next party, lodge or entertainment. Rush coupon TODAY. Money back if not satisfied.

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You may send me the Musical Saw, Soft Hammer and Free Course of Instruction. I will deposit with postman \$4.85 plus postage. If not entirely satisfied I will return the shipment within three days and you will refund my money.

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Address.....

Shipments to Canada, Cuba, Philippine Islands, and all points outside the U. S. cannot be made C. O. D. Send \$5.25 with this coupon. We pay postage.

Home Workshop Chemistry

(Continued from page 132)

but first try a small quantity, about a teaspoonful, to see if the resulting color will be dark enough. Such dye as rubber-stamp ink can be used, and if this is not available, it is possible to use the lead of an indelible pencil. This lead will dissolve in the liquid and dye it sufficiently for use.

Apply the ink with either pen or brush. The result will be a ground-glass effect in the color of the dye employed.

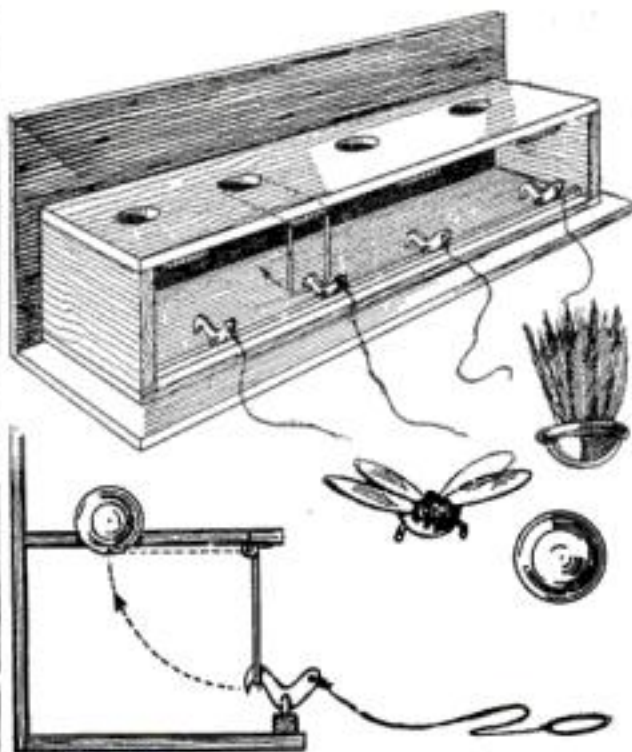
To remove a rusted machine screw from metal parts, put a little oil on the screw. Heat a long iron wire over an alcohol burner or other heater to red heat and hold the wire on the screw head for a minute or two. Let the screw cool, adding more oil if all has evaporated. When cold, the screw usually can be removed with ease. If it still refuses to loosen, heat again and apply more oil. This is one of the best and quickest methods of removing rusted machine screws.

"Catch 'Em Alive" Game

(Continued from page 96)

like stage scenery. This is to prevent the catchers from seeing the flying objects until they are well in the air.

The objects may be light celluloid balls, shuttlecocks or light birds or flies made of wood and wire. Their varying weights will give different rates and directions of flight, thus adding to the excitement. Each butterfly net is a ring of wire about



Flat mouse-traps or springs taken from them are used to shoot the objects into the air

6 in. in diameter, which is fastened to a light handle and covered with a small net.

To play the game, one person pulls the mouse-trap springs down until the catches engage them, places the objects in the holes, and springs the traps, one at a time, by pulling the strings. The strings should be bunched together so that the players will not know which trap is to be sprung.

ANOTHER ingenious and amusing game—one of quick wit rather than dexterity—has been designed by Captain McCann. How to make it will be told in the January issue of POPULAR SCIENCE MONTHLY.



General Motors Trucks

Strength for the Hardest Task

In every line of hauling where super-strength is needed, GMC trucks are to be found upon the hardest jobs.

Not alone because GMC trucks are designed and built to perform faithfully or because they are proving daily their fitness to assume the heaviest labors—

But also because truck buyers realize the additional strength which every GMC has behind it—

The strength provided by the experience of its builders combined with the resources of General Motors—the world's largest automotive corporation.

GENERAL MOTORS TRUCK COMPANY

Division of General Motors Corporation
PONTIAC, MICHIGAN



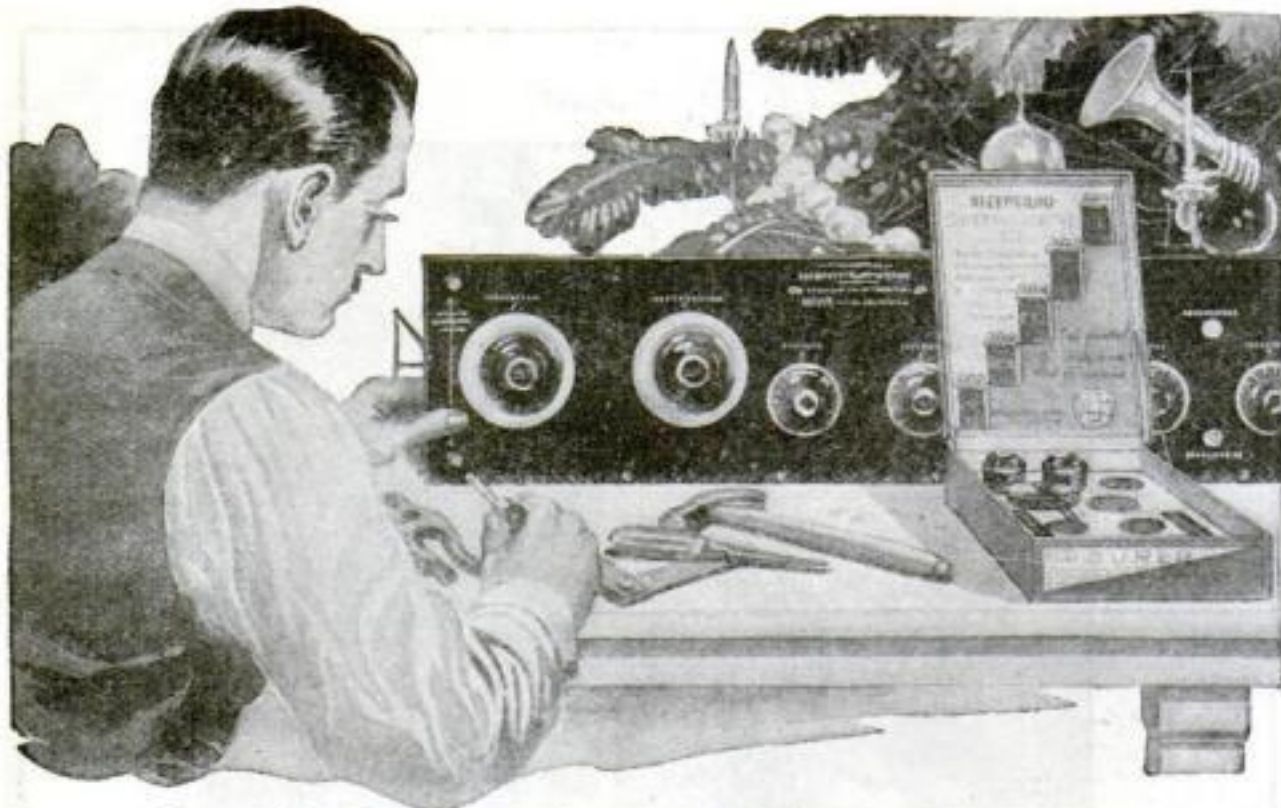
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Gentlemen:

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NO matter what you expect from a receiver—whether distance, volume, selectivity, or clarity—the wonderful "Super-Het" will give it to you. This receiving set will make "next-door neighbors" of broadcasting stations from the Atlantic to the Pacific.

Now everybody can afford to own the famous "Super-Het" all radio fans are talking about. How? By building it yourself. Marvelous as are the results you can secure from the "Super-Het," the circuit is easy to build.

In the RECEPTRAD Kit, in the illustration above are the essential parts for a "Super-Het" Set, with complete instructions for making, and simple, easy-to-follow blue-prints. This RECEPTRAD Kit can be bought direct from your dealer or by mail for the remarkably low price of \$53.50. Or if you prefer a smaller Kit, containing only the most essential parts, we have one for \$33. Either set will operate a loudspeaker on an outdoor, indoor, or loop aerial.

All parts in this RECEPTRAD Kit have been approved by the POPULAR SCIENCE INSTITUTE OF STANDARDS.

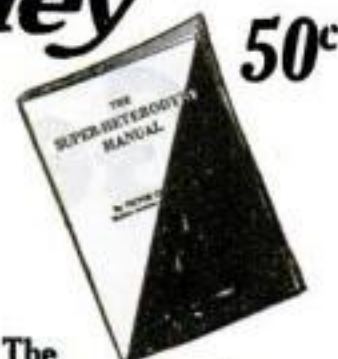
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The Super-Heterodyne Manual

An illustrated working guide to the latest development in radio reception—with complete full-scale construction drawings. This Manual, by Victor Greiff, E.E., of Super-Heterodyne fame will be of the greatest value to every man interested in radio construction work. Use the coupon below to get your copy.



Multiflex

In this one kit are all the essential parts for the new Multiflex Circuit that operates on four tubes with two stages of radio frequency. It can be assembled easily in a few hours. \$29.50 postpaid.

Setting Up Your Christmas Tree

(Continued from page 91)

the paper is wet, but will be almost indistinguishable beneath the coating of plaster after it has hardened. Indeed, there will be just enough printing visible to give the grayish tone of weather-worn rocks. The more time you spend in shaping crags, peaks and other mountain formations, the more realistic the mountain will be. The effect will be enhanced by lighting the model so the rocks will project strong shadows.

Care should be taken to conceal with rocks and boulders the edges of the pan containing the water pool. Small stones may be scattered in the foreground and used for ballast for the railroad track.

Trees may be made in several ways. Pieces of sponge dipped in green paint thinned with turpentine to the consistency of stain, make excellent trees and brush. Sticks may be fastened to sponges for tree-trunks.

Another form of a toy tree is made by whittling shavings on all sides of a stick, from one end to within an inch or two of the other, leaving all intact except those at the end, which should be cut off



Santa Claus's log cabin, a bridge, and two types of simply made miniature trees

to make a pointed tip. Whittle the other end of the stick round for the tree trunk. The homemade trees and brush are illustrated in the accompanying diagram.

The mountain model would be incomplete without Santa Claus's cabin. Use a candy box for this. Fasten two pieces of cardboard to its top to form a gable roof, and fill in the gable ends with triangular pieces of cardboard. Use pieces of grapevine, morning-glory vine, or any small twigs for the wall logs and stick chimney. Coat the cardboard walls with glue, except at the doors and windows, and lay up the twigs in log-cabin fashion. Details of the cabin also are shown.

Throw a pioneer bridge across a chasm for a foot trail crossing, as suggested in the upper photograph on page 91. Make this of tree branches with smaller pieces for handrails and supports (see the diagram above). And do not forget to put up a telephone wire on poles, and to rig up a radio aerial, that Santa Claus may have communication with the world.

A few small animals such as can be purchased in novelty stores may be

(Continued on page 135)

Gentlemen:

Please send me the Super-Heterodyne Manual by Victor Greiff, E.E.
I enclose 50c.

Name

Address

P.S. 12

Improving Hot-Air Furnace Pipes that Do Not Draw

MOST hot-air heating systems have at least one pipe that does not seem to draw heat to the same extent as the other pipes. Such a pipe may be improved by extending it into the hot-air bonnet so that it reaches over the center of the furnace radiator and gets a greater proportion of heat than the other pipes.

To provide such an extension, remove the pipe at the casing and form what I call

SHEET-METAL ROLL
OVER HOT-AIR PIPE

PIPE EXTENSION
OVER HEAT CENTER



Two hot-air pipe extensions, one for a pipeless and the other for a pipe furnace

a "thief" from a piece of tin 20 by 28 in. It should be small enough in diameter to slip through the pipe collar. Cut off the bottom of it at an angle, as shown, and fasten it with wire, to hold it in shape. Then insert it in the collar with the open side over the furnace casting. Replace the main pipe, fastening the joint solidly and covering it with asbestos paper.

The circulation of air from a so-called pipeless furnace can be improved in the morning, when the house is cold, by placing a rolled-up tube of metal about 18 in. high over the warm air or central portion of the floor register. This carries the hot air higher in the room and creates more rapid circulation.—C. W. HUBERTZ.

Sandpaper Roll for Lathe

EVERY one who works with a wood-turning lathe knows the time and trouble that can be saved by putting sandpaper on a round piece of wood and letting the lathe do the work. The



The sandpaper is held by a wedge

problem of how to attach the sheet of sandpaper to the wood has been solved in my own case by the method illustrated. All that is necessary is to turn the wood, saw out a wedge, and bore and countersink three screw holes. Wrap the sandpaper around the block, putting the ends in the groove; then screw the wedge in place.—E. J. Q.

Setting Up Your Christmas Tree

(Continued from page 134)

stood here and there among the rocks, and Santa Claus himself may be on the trail to his cabin. Goldfish in the pool will keep its surface in ripples.

While it is well to lay the railroad tracks in the early stage of construction, to make certain that the tunnel openings are correctly placed, the electrical connections should be left until the last. The transformer or batteries may be concealed within the mountain, but it will be better to have them, as well as the starting switch, exposed at the back of the model.



Let Iver Johnson Be Your Santa Claus

AN Iver Johnson Bicycle—just what brother or sister wants!

The Iver Johnson Truss-Bridge construction assures absolute rigidity, preventing give and sway of the frame during fast pedaling, pushing up hills, or through sand. Also made in Drop-Bar models.

The high carbon seamless steel tubing used in Iver Johnson frames and forks has a tensile strength of 90,000 pounds to the square inch! Fork crowns, cranks, fork-ends, handle-bar stems, seat posts, and other parts are of genuine drop-forgings made in our own plant.

Iver Johnson Bicycles are made to fit all sizes of men and women, boys and girls. Colors: Ivory Black, Copper Bronze, Poilu Blue, Iver Johnson Blue, and Maroon. Every model is finished like a high-priced automobile, with five coats of enamel hand rubbed, and all nickel plating over copper. Best guaranteed equipment.

Iver Johnson Single and Double Barrel Shot Guns

Something that will give father or brother many a good day's sport.

Iver Johnson Champion Single Barrel Shot Guns in various gauges, barrel lengths and models, including the Matted Top Rib and the .410. Also Double Barrel Hammerless Shot Guns. All made in the careful, thorough Iver Johnson way—they are accurate, hard-hitting, dependable guns for long, hard service.

An Iver Johnson Velocipede

Loads of safe fun for any little boy or girl. Built by the same skilled mechanics that make the Iver John-

son Bicycle. Vital parts drop-forged; front axle bearings in a forged, hardened, ground steel housing that does away with all projecting screws and nuts. Flush joints throughout, and full one inch rubber cushion tires.

Made in three sizes, with baked-on enamel, either red or blue with white head; full nickel fork; all nickel plating over copper. Extra number of heavy spokes eliminates all spoke trouble. Other mechanical innovations make the Iver Johnson "America's best liked Velocipede."

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Always a sensible gift for home protection. The famous "Hammer the Hammer" Safety Revolver—all piano wire coiled springs, heat treated; positive cylinder stop; accurate rifling lead lapped, insures straight shooting and maximum velocity.

Handsomely designed, finished in blue, or nickel over copper. 22, 32, 32 Special six shots, and 38 caliber hammer and hammerless models with Regular, Perfect Rubber, Pearl or Western Walnut grips. Barrel lengths, from two to six inches inclusive.

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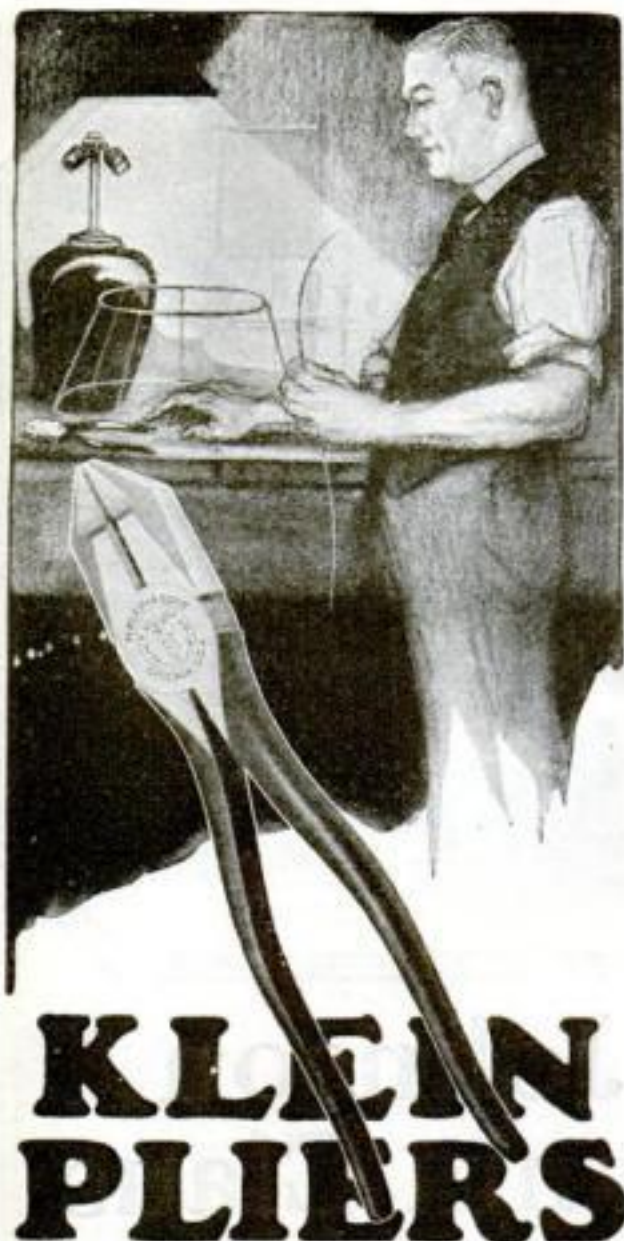
San Francisco: 717 Market St.



IVER JOHNSON

BICYCLES VELOCIPEDES

REVOLVERS SHOT GUNS



For the man who likes to make things, for the boy who is busy with radio, for the amateur or professional, what better Xmas gift than a pair of Klein's?

Drop in to see your hardware dealer — he has a complete stock of Klein's, one of the many patterns will just fit the friend you wish to remember

If he likes tools, he will recognize the trademark. They are the kind of pliers he would be glad to own!



The little booklet pictured is full of useful tables, for both the professional and amateur electrician. It briefly describes, also, the standard pliers used by the skilled craftsman. A postal card will bring you one for your own use—gratis!

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CHICAGO, ILL.

Mathias **KLEIN** & Sons
Established 1830 Chicago, U.S.A.

The Shipshape Home



Repairing Flush Tanks

\$25 or more arrives, is there a hurry-up call for the plumber.

Much expense, both for water and for plumbers, can be avoided if the homeowner will learn how the "innards" of a toilet tank operate and go to the trouble of making the repairs himself. Most plumbers are glad enough to have you do such jobs yourself, as in these days of intensive building, they do not find these minor repair jobs especially profitable.

The one way to make sure that the toilets in your home are not leaking is to give them a thorough examination. Put your ear down near the tank of each one and listen. If you hear a murmur, it means there is a leak.

The rod with the round copper float on its end, which you see extending across the tank when you lift off the cover, sometimes gets out of adjustment so that it fails to shut off the inflow valve before the water in the tank reaches the top of the overflow tube. As a result, there is a slow, constant drainage of water.

To remedy this, bend down just a little the rod to which the copper float is attached. This should be done carefully by bending the rod in the middle when holding it in both hands. Do not attempt to bend the rod by grasping the copper float, as you simply will twist it loose. If necessary, you can unscrew the float first. Next, unscrew the rod itself, then lay the rod on the floor and hold half of it with your foot while you bend it up.

The effect you seek is, of course, to make the float rest a little lower down in the tank so that it will shut down on the incoming water a little sooner. There should be $\frac{1}{2}$ or 1 in. between the surface of the water when the tank is full and the top of the overflow pipe.

It is not necessary to shut off the water before making this adjustment.

Undoubtedly the greatest single source of trouble in toilet tanks is the rubber ball that is supposed to close the outlet of the tank. It often swells or gets hard, which prevents its making a tight seat with the rim of the flush valve.

You can find out whether the ball is

FREQUENTLY leaks in toilet tanks are never noticed. Only when a water-bill of

defective by feeling it. Also look into the bowl of the closet and see if there is a dribbling of water. If so, you have learned why your water-bills are unreasonably high.

If the ball seems defective or is old and worn-looking, the cheap and effective remedy is a new one, which can be purchased from any plumber for less than a dollar. There also is on the market at \$1.25 a pure gum tank-ball of different design from the ordinary variety. This patented mushroom ball is of heavy, pure rubber, and is guaranteed for three years.

The tank-ball should be unscrewed from the rod or "stem" to which it is attached. You may find the thread so corroded that it breaks when you start to unscrew the ball. If so, get a new rod

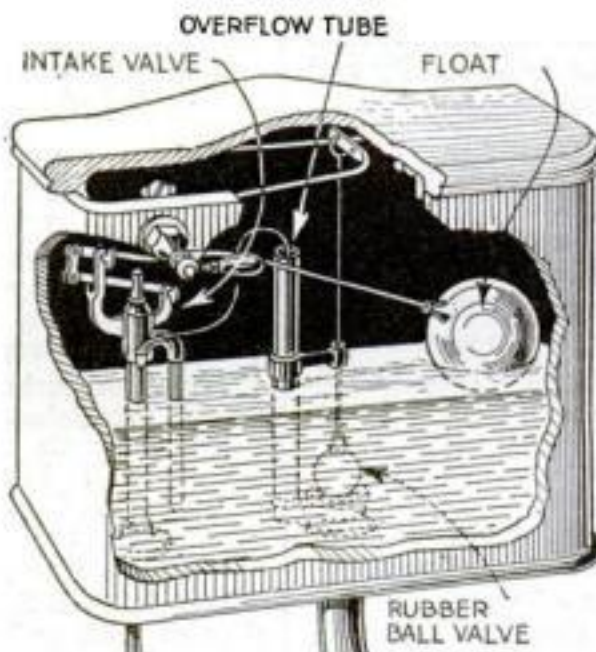
along with a new ball. It will cost only a few cents. A phosphor bronze tank-ball stem, which will not corrode as soon as the commoner kind, is worth getting.

A third frequent cause of leaks is that when the toilet is flushed, the rubber ball does not drop back into correct position, but rests a little off center and does not completely close the outlet. This frequently is due to the guide-arm's being slightly out of alignment with the

center of the flush valve. The remedy is to loosen with a knife-blade or other thin strip of steel (there is no room to operate a screwdriver) the screw that holds the guide-arm on the overflow tube. After loosening this screw, rotate the guide-arm until the stem and ball are exactly over the center of the flush valve.

A fourth danger spot to examine for leaks is the foot of the 1-in. brass overflow tube previously mentioned. This tube has a fine thread on its lower end, where it is screwed into an outlet leading into the flush pipe. Corrosion often starts a leak in the thin metal where this thread is exposed to the water.

Test the condition of the overflow tube by seeing if it is firm. Sometimes a slight twist will cause it to break off at the bottom because the threaded part is eaten half away. In case it is defective, a new tube is to be obtained at your plumber's for about 50 cents. The usual size is 1 by 11 in., but it is safer to measure the old pipe or take it to the plumber to be matched. There is now on



Few repairs to a flush tank of this type require a plumber's services

(Continued on page 137)

The Shipshape Home

(Continued from page 136)

the market an overflow tube made of hard rubber, which will not corrode.

If the tube breaks at the bottom, the remaining fragment of threaded pipe must be got out of the socket into which it is screwed. This is not hard to do, as the corroded metal is soft and pliable. Care must be taken, of course, not to damage the thread into which you want to screw the new tube. The guide-arm attached to the overflow tube must be removed before you can make this replacement.

If any leaks you discover are not located in one of the places mentioned, by all means call a plumber rather than leave them unattended.—E. H. P.

Shallow Cupboards

IN MY kitchen is a press or cupboard made by leaving space between the studding when the room was lathed and plastered. It measures 4 by 4 ft. and is the depth of the 2 by 4 in. studding. There are five shelves each side of the center studding and the outside is trimmed with casing just as are the doors and windows. The back and shelves are covered with oilcloth. White curtains make it look dainty.—MRS. JOHN CLARKSON.



Paint-Brush Holder

A HANDY thing for the shipshape home is a paint-brush holder. All that is needed is a length of stout wire; this will have to be about 26 in. long to hold 10 or 12 brushes. One end is turned up for about 1 in. to make a hook. Eight inches from this point the wire is bent at an angle of about 60 degrees, and 8 in. farther a similar bend is made. The end of the wire is then bent a trifle to hold in the hook at the other end.



A hole slightly larger than the wire is drilled in each brush about $\frac{1}{2}$ in. from the end of the handle, so that the brushes can be run on the wire and hung up.

Disconnecting a Sill-Cock

WHEN no method has been provided for shutting off the garden-hose sill-cock to prevent its freezing in cold weather, it is well to turn off the water temporarily, disconnect the pipe that leads through the foundation, and plug it. If the water line is the usual $\frac{1}{2}$ -in. pipe, an old automobile spark plug may be used as a plug. In the spring the sill-cock and connecting pipe can be replaced readily.—O. M. A.



ATKINS

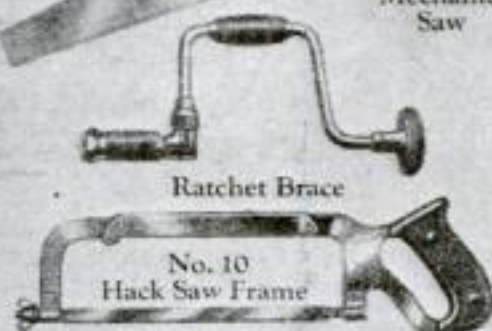


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Atkins Saws are backed by three hundred years of fine saw making. The Atkins trade-mark identifies the world famous saws, built to the highest standards of accuracy, quality and value.

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Only Atkins Saws are made of "Silver Steel"—Atkins Special formula. That's why they hold their edge better, need less fitting and stay sharp longer.

It will pay you to look for the name "Atkins" on any saw you buy. If the Atkins Saw you want is not shown here, ask your hardware dealer about it. He'll gladly point out why an "Atkins" is the better saw for you to buy—why it cuts faster and easier and gives you more real saw service per dollar.

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"Saw Sense," "Saws in the Shop," "Mill Saws" and "Saws on the Farm" are valuable booklets filled with information on saws and their use. We'll be glad to send you any of them. Just mail us the coupon—NOW.

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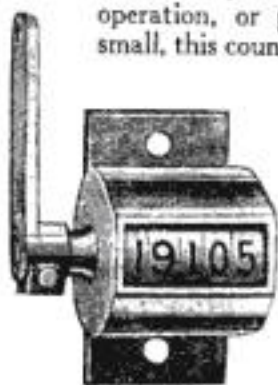
Machines may be "dead metal" or they may be in a state of growth.

You can make them grow in usefulness, in capacity for work. You can check up their actions and correct their faults, with the help of a Veeder Counter.

Whatever makes for better or worse in machine development, *shows up* in the production-count. Whatever results from change or experiment, goes down for your guidance—on a

Veeder COUNTER

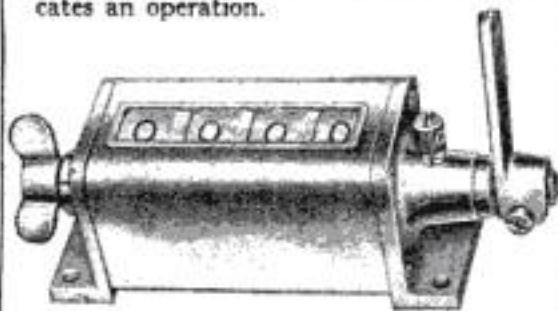
The small Revolution Counter below registers one for a revolution of a shaft, recording a machine operation, or product. Though small, this counter is very durable;



its mechanism will stand a very high rate of speed, making it especially suitable for light, fast-running machines and most adaptable to experimental work. If run backward the counter subtracts.

Price \$2.00. (Cut 4-5 size.) Small Rotary Ratchet Counter, to register reciprocating movements of small machines, also \$2.00.

The Revolution Set-Back Counter below records the output of the larger machines where a shaft-revolution indicates an operation.



Sets back to zero from any figure by turning knob once around. Supplied with from four to ten figure-wheels, as required. Price with four figure-wheels as illustrated, \$10.00—subject to discount. *Cut less than one-half size.* Set-Back Rotary Ratchet Counter, to record reciprocating movements as on punch presses, \$11.50 (list).

The Veeder booklet shows instruments that "count everything on earth." It's an 80-page book, entirely free.

The Veeder Mfg. Co.
44 Sargeant St. Hartford, Conn.

The Shipshape Home

(Continued from page 137)

Applying Weather-Strip

VERY few homeowners would tolerate a broken window or a glass panel removed from an outside door, yet many homes have unprotected windows and doors with many crevices. The openings may be inconspicuous, but they add to the fuel bill and detract from the family's comfort. Only plumbers can tell how many pipes burst every winter because of cold drafts of air from ill-fitting windows and doors.

The work of weather-stripping a house is far from difficult unless some of the

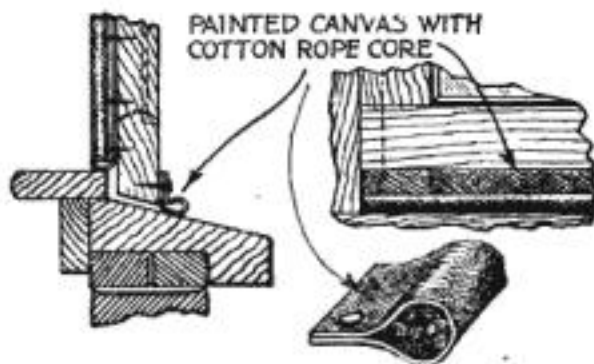


Fig. 1. Homemade weather-strip made of canvas and soft cotton rope, fastened with brass tacks

special patent metal weather-strips are used, when a skilled worker and special tools are needed. Luckily the home worker can obtain good results with the simpler types of weather-strips.

Combined wood-and-felt and wood-and-rubber strips, metal-and-rubber strips, and flexible rubber and felt strips are common varieties that can be purchased at hardware stores. Preference and price govern the type selected, but all are good if properly applied. Indeed, the ingenious home-owner can make up weather-stripping in an emergency from other material, if he wishes.

One of the best improvised weather-strips that the writer has seen was an ap-

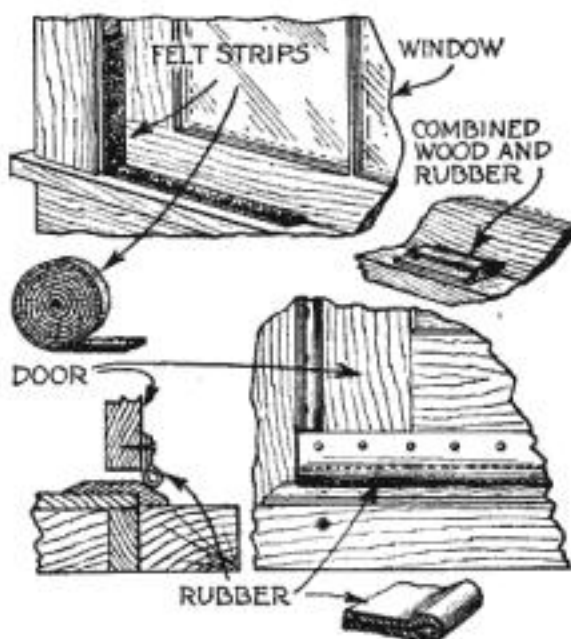
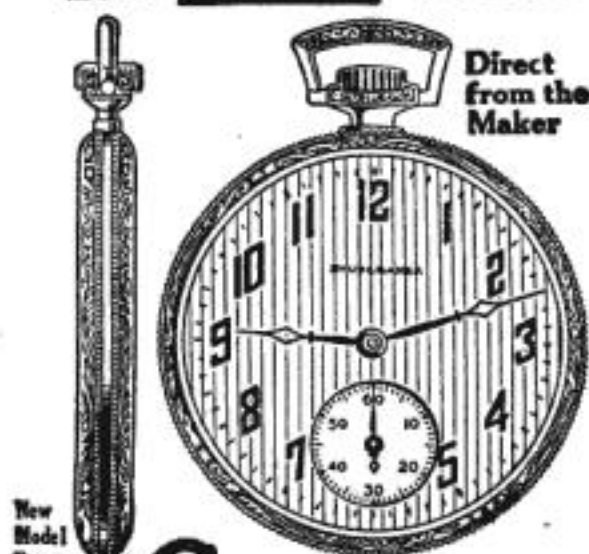


Fig. 2. Method of applying felt, rubber and combined wood-and-rubber or wood-and-felt strips

plication of canvas and cotton rope, illustrated in Fig. 1. Strips of canvas 2½ in. wide were folded over a rope core made of soft cotton string. These were fastened with brass tacks spaced 2 in. apart. The strips then were painted with linseed oil
(Continued on page 139)

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The Shipshape Home

(Continued from page 138)

and lead. This made durable, neat, and extremely serviceable insulation.

In another instance a home-owner who had difficulty in obtaining weather-strips that would be effective at the lower edges of the doors, cut some strips of rubber from old automobile inner tubes. These were folded and tacked on, the rubber forming a cushion-like inclosure. This proved so satisfactory that the owner substituted the homemade weather-stripping throughout the house.

There are a few points to remember in applying the simpler types of weather-stripping mentioned above. At the bottom of doors it is preferable to place the strip on the outside edge of the door, if possible, but if the door swings in the strip often has to be placed on the inside so as not to interfere with closing the door. The side strips for the door are placed on the door-stops.

If the inside stops of a common double-hung window-sash are fitted tightly enough against the lower sash—and they can be removed easily and made tight—it usually is not necessary to put weather-stripping around the lower sash. However, a strip on the outside of the bottom rail of the lower sash is sometimes desirable and is especially so with the casement type of window.

At the junction of the upper and lower sash, there is usually no need for weather-strip, if the catch is adjusted to pull the sashes close together. If necessary, a single thickness of felt or rubber may be placed on the beveled inside face of the meeting rail of the upper sash.

Where weather-strip is mainly necessary on windows is around the sides and top of the upper sash on the outside. Weather-strip made with felt should not be nailed so as to press too snugly against the window, as it may swell.

The careful worker will find it advisable to tack on weather-strips at first in a few places and then move the windows up and down before nailing the strips solidly.

The value of weather-stripping depends upon the care taken in fitting it, and even the cheapest grades of commercial strips or improvised strips can be made to exclude the cold.—G. A. LUERS.

Dollars for Ideas

IN KEEPING your home shipshape, you often hit upon ingenious, time-saving, labor-saving and money-saving ideas.

If you will describe, in not more than 200 words, each of your ingenious keeping-the-home-shipshape methods, we will pay \$2 for every one published. Include a pencil sketch or photograph to illustrate the idea, if possible, and address your letter to the Home Workshop Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York.

Power



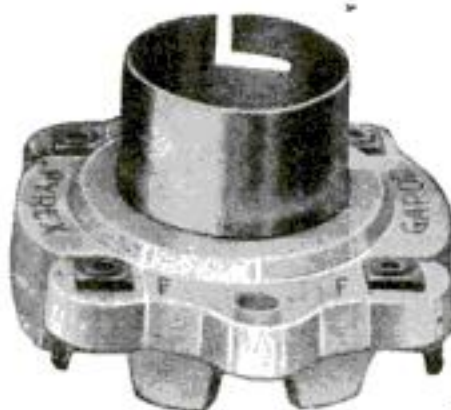
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The Garod-Pyrex Glass V. T. Socket—\$1.50

Exhaustive tests prove "Pyrex" lowest loss insulating material for R. F. C. yet presented, excepting quartz. It is strong, heat resisting, and free from surface condensation. Pyrex sockets exclusively controlled by Garod Corp.

If your dealer can not supply you—send us his name and \$1.50, plus postage for each socket.



GAROD
NEUTRODYNE

Georgian Model \$400 Garod Model V \$195 Garod RAF Model \$135
(Pictured Above)

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WE MUST call for help in our endeavor to explain just what we mean by GAROD Power. If you want to begin to understand Power as applied to GAROD, you cannot do better than consult Noah Webster and carefully analyze his synonyms for the word. But—even this master of words has fallen short when it comes to accurately defining the POWER of GAROD.

Garod Power is:

- POWER**—to produce great volume
- POWER**—to bring in distant stations
- POWER**—to work through local stations
- POWER**—to moderate or intensify volume
- POWER**—to render the original quality of tone transmitted
- POWER**—to select your program
- POWER**—to get the best out of the program

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Dept. 1789 — Chicago, Ill.

I enclose \$1.00. Send All Wool Sweater, No. F-12. If I am not delighted with the sweater, I may return it and get my money back. Otherwise I will pay the bargain price on your terms; \$1.00 with coupon, and only \$1.00 monthly. Total price, \$6.98.

Size Name
Maroon ☐ Address
Navy Blue ☐
Seal Brown ☐

Post Office State

I have lived in this town yrs. And before that I lived in for yrs.

Nationality Own ☐ Married ☐
or Color Age Rent ☐ Single ☐

Present Occupation Employers Name

Give names of merchants who know you personally

Name Town State

Name Town State

If you have ever bought goods on credit by mail, tell us from whom. If there is anything else you wish to tell us about yourself, write on a piece of paper and enclose it with this coupon. But the coupon alone, fully filled out, will do. That's all we want to know and we're ready to send the sweater at once. No red tape. No C. O. D.

The Vest Pocket
BOOKKEEPER

A simple and concise method of practical bookkeeping, with short cuts in figures and complete instructions for the correct keeping of books of accounts. A working model adapted to the novice and business man, by F. M. Payne; 160 pages, size 3 x 6 inches, \$1.00 postpaid.

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We want one auto owner in each locality to use and advertise Armour Cords. Make big money by simply sending us orders from friends and neighbors. Sample Tires Furnished. No capital or experience needed. We deliver and collect direct. Pay you daily. **GUARANTEED FOR 12,500 MILES** of Satisfactory Service against Rim Cut, Tread Separation, and Blow-Out on Adjustment Replacement basis. Direct from factory to user. Write today for great special offer to agents and low factory prices.
Armour Tire & Rubber Co.
Dept. 1750 Dayton, Ohio

Artistic Gifts Made from
Photo Printing Paper

By Kenneth B. Murray

ARTISTIC gifts made in the home workshop may be enhanced in many cases with the aid of photographic printing paper so treated that it has the appearance of shiny, fine grained marble.

The paper is made by printing in the ordinary way, using as a negative a piece

Fig. 1 (at right):
An orna-
mental
book-
mark



Fig. 2 (at left):
The photograph
and the decorative
border were made
at one printing.
The stippled ef-
fect around the
edges is obtained
by printing
through fine red
tissue paper

of thin red tissue paper. An exposure of five or 10 seconds is sufficient. The red tissue has tiny holes in it, invisible to the naked eye. The light passes through these holes and gives the marble effect to the printing paper. Development is made in the usual manner.

Figure 1 illustrates a bookmark of double-weight paper prepared in this way. In Fig. 2 is shown how the ornamental paper obtained by this method may be used to form a border for a photograph. In this case the red tissue has a hole the size of the negative, and

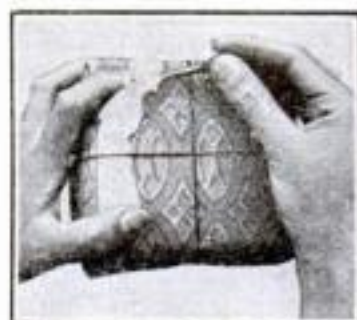


Fig. 3
(above):
Silhouette
applied to
Christmas
package

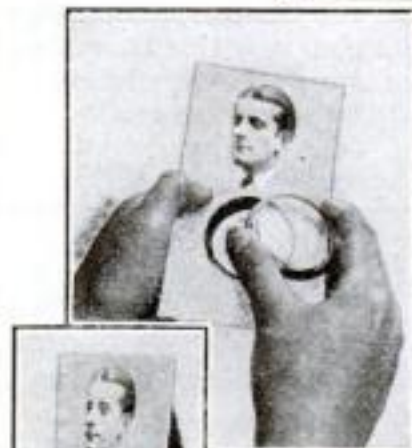


Fig. 4
(at left):
An easily
and cheaply
made desk
clock dec-
orated with
photograph

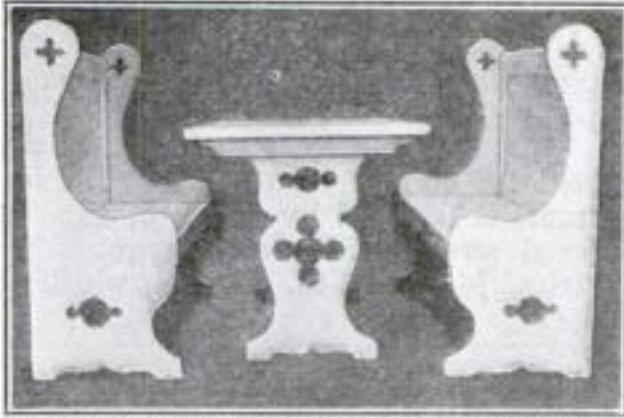
the negative itself takes the place of the tissue cut away. Both border and picture are printed at the same time.

A novelty in the way of a silhouette cut from the paper and pasted on a Christmas package is shown in Fig. 3.

By using double-weight paper and reinforcing it with cardboard, a pretty desk clock can be made, as in Fig. 4. A picture of the donor is printed on the paper at the same time the marble-like effect is pro-

(Continued on page 141)

Pullman Dining Alcove Built from Home Workshop Blueprint



Dining alcove made by 16-year-old John Mitchell from Home Workshop Blueprint No. 33

USING POPULAR SCIENCE MONTHLY'S Blueprint No. 33 as a guide, John Mitchell, of Point Pleasant, N. J., who is only 16 years old, built the Pullman dining alcove illustrated above. He writes:

Inclosed you will find a photo of a dining-alcove set made with the aid of your blueprint, which I found very clear to understand. It is greatly admired by all who see it; they think it the prettiest design they have seen. I think a great deal of your book and have made many useful things around the house from it during my vacation from school. I am 16 years of age and attend high school.

Those who read L. Porter Moore's article last month on built-in features and wish to construct a modern breakfast corner will save time and money by obtaining this blueprint.

This month's new blueprint is the simplified bookcase illustrated on page 92.

Complete List of Blueprints

ANY one of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to provide, upon request, information relative to tools, material, or equipment.

Blueprint Service Dept.
Popular Science Monthly
250 Fourth Avenue, New York

GENTLEMEN:

Send me the blueprint, or blueprints, I have underlined below, for which I inclose.....cents:

No.	Title	Price
1.	Sewing Table.....	25c
2.	Smoking Cabinet.....	25c
3.	Book Trough End Table.....	25c
4.	Kitchen Cabinet.....	25c
5.	Two-Stage Radio Receiving Set.....	25c
6.	Shaving Cabinet.....	25c
7.	Arbor with Gate and Seats.....	25c
8.	Porch Swing.....	25c
9.	Bench and Tilt-Top Table.....	25c
10.	Electric Washing Machine.....	25c
11.	Tea Wagon.....	25c
12.	Toy Train, Horse, and House.....	25c
13.	Home Workshop Bench.....	25c
14.	Inlaid Radio Cabinet.....	25c
15.	Cedar and Mahogany Chest.....	25c
16.	Telephone Table and Stool.....	25c
17.	Grandfather's Clock.....	25c
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19.	Colonial Writing Desk.....	25c
20.	Girl's Cabinet and Desk.....	25c
21.	Pergola Garage.....	25c
22.	Gateleg Table.....	25c
23.	Sailing Outfit for Canoe.....	25c
24.	Baby's Crib and Play Pen.....	25c
25.	Kitchen Cabinet Work Table.....	25c
26.	Pullman Play Table.....	25c
27.	Toy Tea Cart, Garage, etc.....	25c
28.	Tool Cabinet, Bench Hook, etc.....	25c
29.	Priscilla Sewing Cabinets.....	25c
30.	Chinese Game Table.....	25c
31.	Pullman Dining Alcove.....	25c
32.	Trellises for House and Garden.....	25c
33.	Simplified Radio Cabinet.....	25c
34.	Rush-Bottom Arm-Chair.....	25c
35.	Simplified Bookcase.....	25c

Name.....
(Please print)

Street.....

City and State.....



NOTE: Remember that Miraco Tuned Radio Frequency Sets are built and fully guaranteed by a reliable, long established concern, one of the first to build quality sets. Thousands of users endorse their satisfactory performance. Send for further testimony of coast to coast reception and proof that Miraco Sets are numbered among radio's finest low-priced receivers.

COLORADO HEARS N. Y. AND CALIFORNIA
"I heard New York and California the first night on my Miraco."
—Fred Knappenburg, Jr., Burns, Colo.

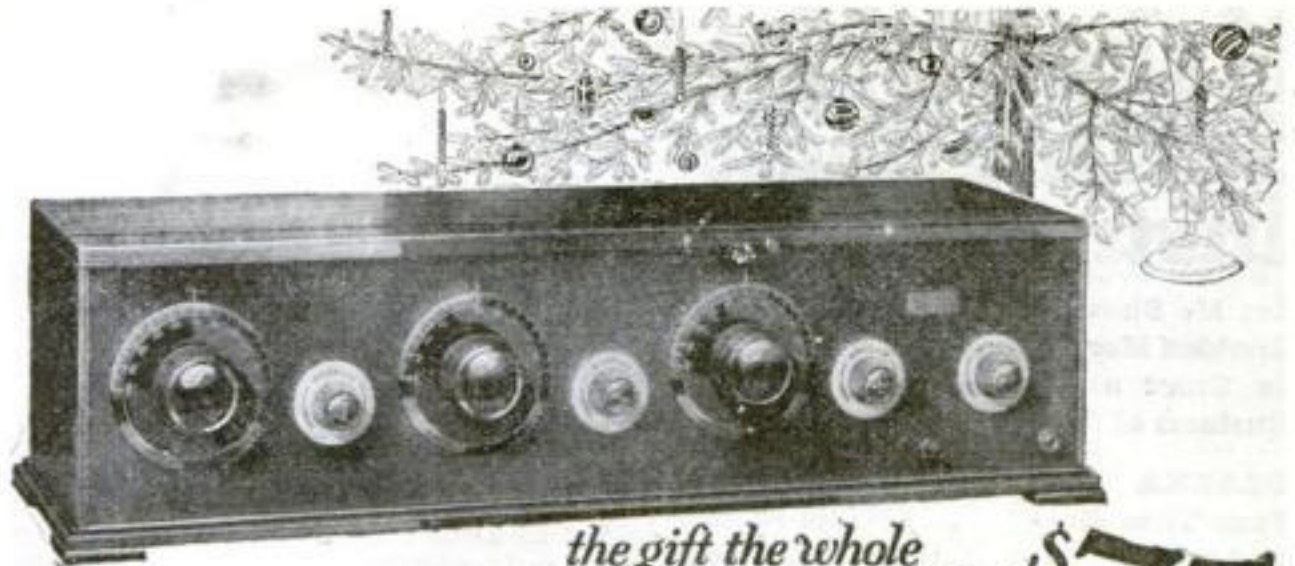
NEW YORK HEARS ALASKA
"Received 115 stations with my Miraco, including WLAV Fairbanks, Alaska, NNW Panama, KSL, San Francisco, WEV Houston, Texas and CFAC Calgary, Canada."
—E. D. Elliott, Milford, N. Y.

OHIO HEARS 12 CITIES THE FIRST NIGHT
"The first night we tried out our Miraco we got Atlanta, Philadelphia, Washington, New York, Detroit, Davenport, Omaha, Hastings, Nebr., Chicago, Schenectady, Pittsburgh and Texas. We think that was real good for beginners."
—W. L. Musselman, New Carlisle, Ohio.

NORTH DAKOTA HEARS 43 STATIONS FIRST 3 DAYS
"Bought a Miraco, operated it three days and received: WGR, WLW, WDAP, KFI, CHOM, WJAZ, WMAI, CFAC, WTAM, KYW, KFAX, KLZ, WWJ, WOC, WPA, 9PI, K D A K, W B A P, KFKX, PWX, WOS, WHB, WDAF, WHAS, KFI, KFKB, WLAG, W B A H, W H A, W C A L, W E A F, W O A W, W C A E, KGW, WCK, WGY, KSD, WPAM, CKY, WCB, WTAY. Who has a better record?"
—W. L. Johnson, Ashley, N. D.

CONNECTICUT HEARS 'EM LOUD AND CLEAR
"Immediately connected up my Miraco and received Pittsburgh, Chicago, and many others loud and clear. Expected set would be good but it has surpassed my expectations."
—A. M. Alexander, Winsted, Conn.

All Miraco sets are factory - built, completely assembled, factory-tested and factory-guaranteed. They may be used with any tubes or batteries.



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FIVE TUBE OUTFIT IN BEAUTIFUL SOLID MAHOGANY CASE
Unsurpassed selectivity, sensitivity, range, volume and tone combined

A BEAUTIFUL sweet toned, five tube, "coast to coast loud speaker" set — factory - built, factory - tested and factory guaranteed by one of America's oldest and most reliable manufacturers of quality sets. Composed of the finest parts obtainable. Equipped with the latest improvements, refinements and features found on costliest sets. Encased in a handsome hand-rubbed solid mahogany cabinet.

Simple to connect and operate. No experience necessary. Even a beginner can quickly learn to cut through the locals,

get far-off programs loud and clear on the speaker, log all stations and bring them back at will. Full directions with each set. The Miraco "Ultra 5" is non-radiating, non-howling, non-distorting. Has cut-out switch—and a first stage phone jack, for tuning — on front of Bakelite panel. Bakelite sub-base under which all wiring is hidden, and other newest features.

Thoroughly tested and approved by radio's highest authorities. For only \$75—a price which has rocked the industry! Unquestionably the most astounding value ever offered radio lovers. Operate on storage battery or dry cells.

Other Miraco Long Distance Sets \$14³⁵_{up}



This wonderful new Miraco Model R-3 is the three-tube, long distance, loud speaker set that has created such a sensation. Easy to tune and log. Covers wave lengths 150 to 625 meters. Detector acts also as a tuned r.f. amplifier. 2 stages a.f. amplification. Has no equal for simplicity, volume, range or clearness at anywhere near its price of \$29.50.



Miraco Model R is called by users "Radio's finest low priced quality receiver." One tube acts as a tuned radio frequency amplifier and detector combined. A great distance getter. Easy to operate and log. Covers all wave lengths 150 to 625 meters. Like all Miraco sets, it uses storage battery or dry cells. Never such value before at only \$14.35.



The Improved Miraco 1925 Model MW — with filament switch, phone jack, etc.—is a four tube outfit that users in every state report outperforms and out-distances sets twice as expensive. Operates loud speaker on distance stations. One stage tuned r.f. amplification, detector, two stages a.f. amplification. Solid mahogany cabinet. Value beyond duplication at \$54.50.

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OZARKA
Four-Tube Sets
as Low as
\$39⁵⁰



J. Matheson Bell
President

JUST as sure as you can show me that you are the right kind of a man—that you have ambition and spunk and are determined to better your position and condition in life—just that sure am I that I can show you a plan whereby you can make a success in this new field, and reach your goal.

Radio has grown from nothing within three years to be one of the greatest industries in this country. I am satisfied I can show you a plan whereby you can make big money in territory not already covered, the same as I have with thousands of others.

The Ozarka Plan is the first and only one of its kind which enables the average man to start a manufacturing business of his own and pay no one any unnecessary profit. It will give the right kind of a man an opportunity to get on his feet even in his spare time, and establish himself in a permanent and profitable business of his own.

The man I am looking for is having a hard time making ends meet. He is willing to learn—willing to try and try hard, if he can only be shown and given a helping hand to get started.

The man I am looking for is not a "floater." He has a good position and he has held that position for some time. He is well and favorably known in his community—he is honest, hard working and industrious. He may not have much money—he is not completely broke and looking for a job. Generally he has a family and wants to do the best he can possibly do for that family.

During the past three years I have shown over two thousand men how to

get "out of the rut"—how to pull themselves up and get on their feet. I am satisfied I can do this for you, or any other man, if you are willing to do your part. The public is buying radio instruments more and more every day, and yet in this wonderful business there is a field wide open for you.

Our entire plan of selling is described in a large illustrated book "The Ozarka Plan." This book is free for the asking and, for any man who is determined to improve his condition, it will no doubt be just what he is looking for. It has been the turning point in the lives of a great many men—it will mean the same to you. At any rate, you will enjoy reading it, because it is a story of men, a story of their successes and failures. It proves why some men fail while others succeed. It shows clearly why a few men in this country are the employers of mobs of men who are toiling daily to make millionaires out of a few.

Thousands of men have written me and stated that this book is the most wonderful story they have ever read. After all, it is the story of myself

and the Ozarka organization, who have started from absolutely nothing in this world and pounded our way to success, without even the advantage of what is now known as an education.

I don't care who you are, nor what you have done in the past. I know that this book will be a revelation to you, and yet it is only a question of writing me a letter and telling me about yourself—tell me what you have done—tell me what you are now doing—and ask for Book No. 100. In doing so, however, don't fail to give the name of your county.

The Ozarka Plan has been a very expensive book for us to publish, but nevertheless, we will gladly send it to any man who feels that there is still an opportunity left for him to get what he wants.



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AGENTS

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or more. 9 out of 10 women buy. Produces keen edge quickly. Sells for 50c.
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PLAY A TUNE IN 10 MINUTES!



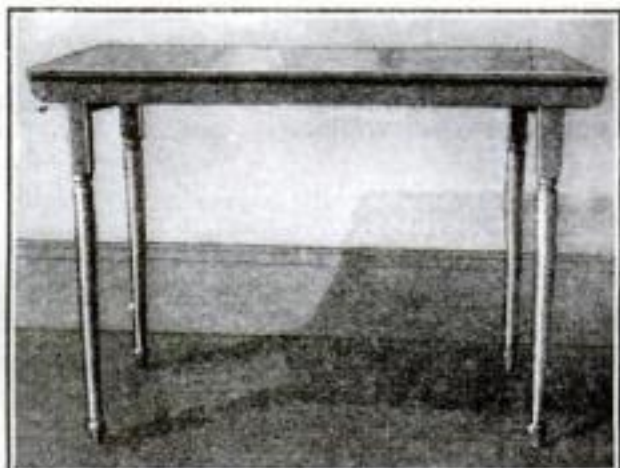
On Ukulele, Banjo, Ukulele, Mandolin, Tenor Banjo or Guitar. Amazing new invention. No knowledge of music necessary, no practice—you can play tunes right away. Easily attached to any instrument. Simply press numbered keys. Play tone when played the old way. Send for **FREE BOOK** and bargain catalogue of musical instruments. No obligations. Have fun, money, popularity. Write today. **FERRY & CO., 3222 N. Halsted St., Dept. 8789, Chicago, Ill.**

Free Book

Light Folding Table Built to Give Long Service

THIS folding table for card-playing or occasional use, may be built of clear pine, basswood or one of the more expensive cabinet woods.

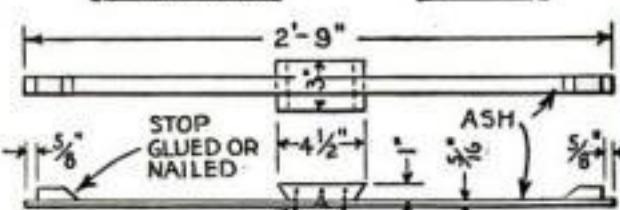
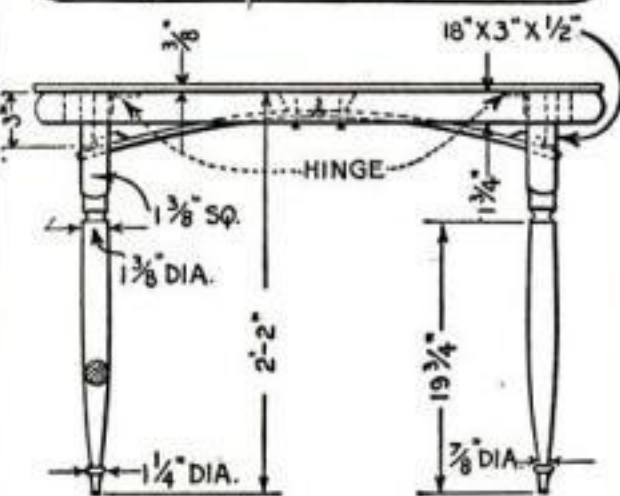
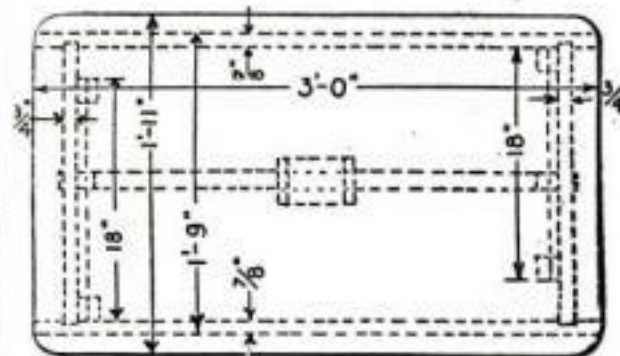
The top is $\frac{3}{8}$ by 23 in. by 3 ft. with rounded corners. On the under side a frame is fastened by means of flat-head wood screws. The frame requires two strips, $\frac{7}{8}$ by $1\frac{3}{4}$ in. by 3 ft., which are



This useful little table may be stored in a small space, as the legs fold inward

connected 1 in. from each end by two cross members, $\frac{3}{4}$ by $1\frac{3}{4}$ by 20 in.

The four legs are turned to the dimensions shown from $1\frac{3}{8}$ -in. square stock. Each pair is connected by a strip $\frac{1}{2}$ by 3 by 18 in. They are fastened to the top by means of table hinges or other extra



NAIL HOLES LARGER THAN NAILS

Top and front views of the table and details of the wooden spring catch

wide and heavy hinges, although ordinary butt hinges will serve.

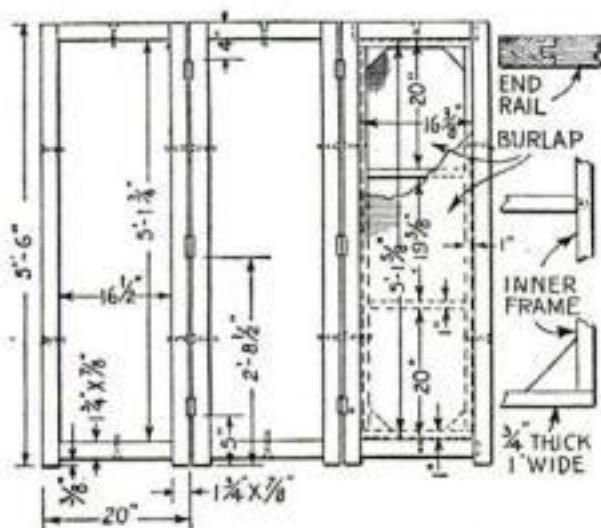
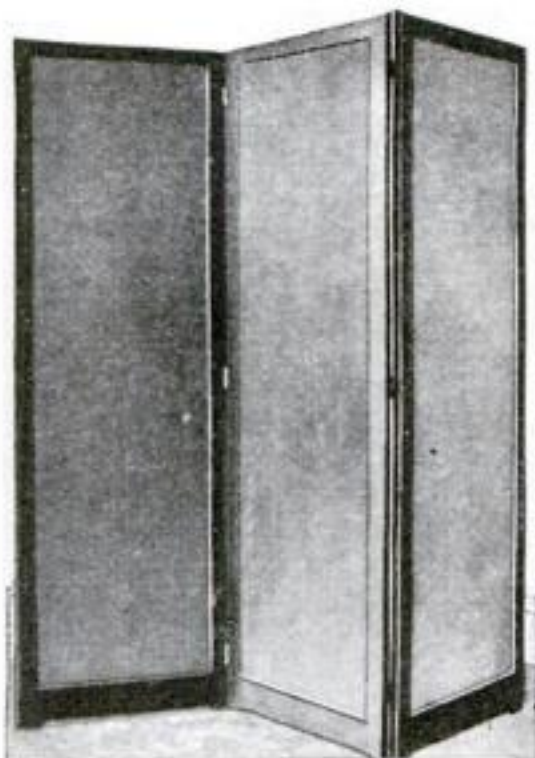
Located centrally on the under side of the top is a block to which a strip of ash, $\frac{5}{16}$ by 1 by 32 in., is fastened. This strip serves as a spring to prevent the legs from collapsing when extended.

How to Make an Attractive Burlap-Covered Screen

ALTHOUGH the screen illustrated below is simple in construction, it may be placed alongside the best commercial furniture. Mahogany, walnut or cherry may be used, as the builder desires.

The stock should be finished $\frac{3}{8}$ in. thick. First, make the six side members, each having a length of 5 ft. 6 in. and a width of $1\frac{3}{4}$ in. The six end rails are each $17\frac{1}{2}$ in. long and $1\frac{3}{4}$ in. wide. This allows a tenon $\frac{1}{2}$ in. long on each end of the rails.

Each frame is assembled with a good grade of liquid glue. They are hinged together with six double-acting screen



The finished screen and details of the construction of the outer and inner frames

hinges, which are to be obtained at any well-stocked hardware store. The frames are finished in shellac and wax, or varnished, as preferred.

The burlap covering is tacked to frames of spruce or similar wood, which are made to fit inside the outer frames. Details in the accompanying illustration show how the corners and cross members are joined. The outside dimensions should be slightly less than the inside dimensions of the outer frames. They are fastened together only with glue and nails, as the covering material gives additional strength.

These inner frames are covered on both sides with burlap or other material, fastened with small carpet tacks, and then are held in place by means of flat head brass wood screws, which pass through the rails of the outer frames.—W. J. E.



Big Money and a Barrel of Fun!

First-Class Saxophonists make big money, and the work is easy and pleasant. You might easily become a wizard like Tom Brown, of the famous Six Brown Brothers or Ross Gorman, Saxophonist with Paul Whiteman. Or you might be a great record-maker like Clyde Doerr or Bennie Krueger or Joseph C. Smith. \$100 to \$500 weekly is not unusual for musicians of such ability to earn.

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player. It's the ideal instrument for social entertainment. It is a key to social popularity. At parties, everywhere, the Saxophone player is the center of attraction.

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Three lessons sent free with the instrument start you. Besides being so easy to play - we make it very easy to pay for one of these Buescher Saxophones with our simple plan of deferred payments. Play and earn while you pay.

BUESCHER BAND INSTRUMENT CO.

Everything in Band and Orchestra Instruments

340 Buescher Block, Elkhart, Ind.

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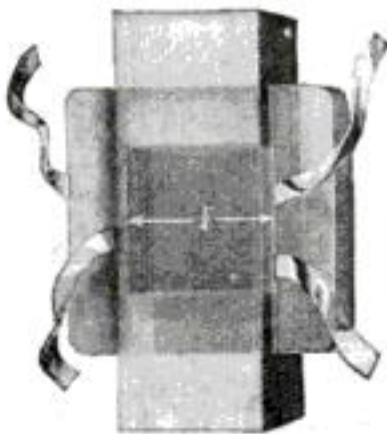
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-Very interesting. Tells all about the various Buescher Saxophones, with pictures of the famous professionals and orchestras. Send coupon for a copy. Mention any other instrument in which you may be interested.



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Gentlemen: I am interested in the instrument checked below:	
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(Mention any other instrument interested in)	
Name.....	
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Town.....	State.....

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The Exclusive
THORDARSON SQUARE COIL
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The Thordarson-made layer-wound SQUARE coil fits snugly around the square core. Coil can't turn—no open circuits due to layers slipping. No air spaces between coil and core (exclusive Thordarson feature!)—no lost energy, no lost volume (especially on low notes), no leaks from primary to cause howls in set. (Thordarsons are quiet, even on the third stage!) Over-size core (3/4 in. cross section) provides 50% larger magnetic circuit—minimizes core losses, prevents over-saturation. Broad ribbon leads locked in the coil give short, direct and more durable connections to the patented inner-locked terminal posts—no tangled or broken wires inside case (exclusive!). Each Thordarson transformer comes completely protected, shielded and tightly clamped in a stout case. No rivets or screws through the special silicon steel core to cause short circuits or eddy current losses between the laminations (exclusive!). Do you wonder that Thordarson produces more transformers for more makers of quality sets than all competitors combined?

ZENITH, Kennedy, Radiodyne, Pathe, Ultra-dyne, Murdock, Howard, Ozarka, Michigan, Music, Pfanstiehl, Phoenix, Andrews, Malone Lemon, Audiola, Gates, Globe, Harmony, Hartman, Odell-Ferry, Peerless, Saal, Duck's DeLuxe and many other makers of national prominence—after exhaustive tests of all transformers—are using Thordarsons as standard equipment!

Can you imagine these famous builders of sets that range in price up to hundreds of dollars, jeopardizing the tone quality of their instruments with anything short of the best amplification? Of course not! And that is why they all use Thordarsons. *Superiority proved!*

Follow the lead of the leaders—build or replace with Thordarsons or buy Thordarson-equipped sets. All dealers can now supply you. Audio frequency types in three ratios: 2-1, \$5; 3 1/2-1, \$4; 6-1, \$4.50. Power Amplifying (for push-pull circuits), pair \$13. Write for latest literature.

THORDARSON *Super* AMPLIFYING TRANSFORMERS

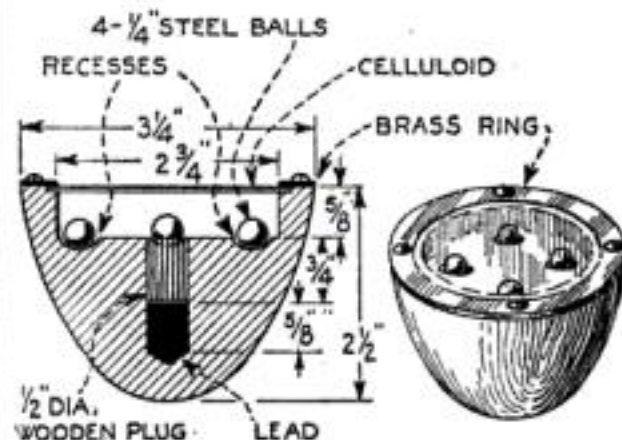
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Transformer Specialists Since 1895
WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS
Chicago, U.S.A.

Spinning the Container Solves Novel Four-Ball Puzzle

TO PLACE the four balls of this puzzle in the four very shallow holes is an amusing problem. The natural way is to incline the cone, so that the balls can be placed one at a time. You will soon find, however, that you cannot succeed along those lines, for placing the second



The puzzle and cross section through it. Note lead weight that aids in spinning it

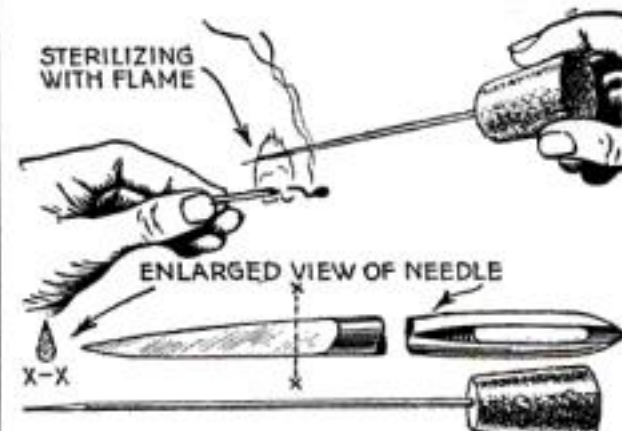
ball causes the first to roll out of its recess. The trick is to spin the cone like a top.

The cone is turned from dry wood and a recess is cut in the top for a celluloid disk. The best way of holding the latter is to cut a ring from thin brass and fasten it with six small wood screws.

A lead filling must be provided to make the cone spin well. A hole 1/2 in. in diameter and 1 3/8 in. deep is drilled in the center, and melted lead is poured in to a depth of about 5/8 in. The hole is then closed with a wooden plug. The balls are from an old ball bearing.—C. A. O.

Small First Aid Lancet Made from Darning Needle

A GOOD surgical needle of the lancet type for home use can be made from a large darning needle. The point is ground and whetted to the shape shown,



How the point of the darning needle is sharpened and sterilized with fire before use

which gives a keen penetrating and cutting edge. A cork pushed on the eye end serves as a handle.

Before using such a needle, sterilize the point by holding it in the flame of a gas jet or match.—J. R.

For mending small cracks in steam boilers of house-heating plants, a good cement can be made from two parts finely powdered litharge, one part very fine sand, and one part of quicklime that has become slaked through exposure to the air. Just before being used, this mixture is moistened with boiled linseed oil to a paste-like consistency.

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SPECIAL INTRODUCTORY OFFER to acquaint you with quality—beauty and distinction of GRANADA Hand Sewn SPANISH Leather. Catalog of 300 models free. Newest styles in bill folds, cigarette and cigar cases, coin purses, card cases, rosary cases, match cases, etc.

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For your home shop!

PARKS

Cabinet Shop Special

\$225

with all attachments and motor



HERE'S an all-round woodworker for the small shop. Sturdy, fast and true. The biggest little woodworker ever built. Saw table has 8-in. rip and cross-cut saw, and 4-in. jointer and borer. You can choose from these extra attachments: band saw; shaper; sander; lathe; and motor. Send for Bulletin C-S and complete Parks catalog.

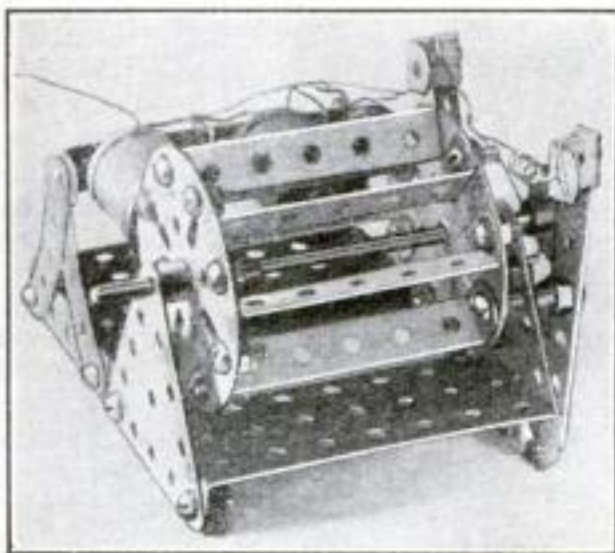
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1547 Knowlton St., Cincinnati, O.
Canadian Factory: 200 Notre Dame East, Montreal, Can.

PARKS
WOODWORKING MACHINES

Constructing a Toy Motor from Junk-Box Parts

TWO electric magnets, obtained from an old door-bell, and a battery furnish the power that turns the armature of this simple toy electric motor of unique design. When the circuit is closed, the magnets attract soft iron bars or rods, which are firmly fastened to two wheels taken from a toy construction set. The circuit is broken or interrupted as the bar approaches the magnet in such a way that the bars are attracted in succession, thus causing the rotation of the shaft.

The shaft carries eight of these iron bars, and also eight contact points, which are nothing more than short bolts. The current leading into the magnets is con-



Old bell magnets and discarded toy parts were used in making this electric motor

nected with one pole of the battery. The other pole of the magnets is brought to the metal upright that carries the shaft.

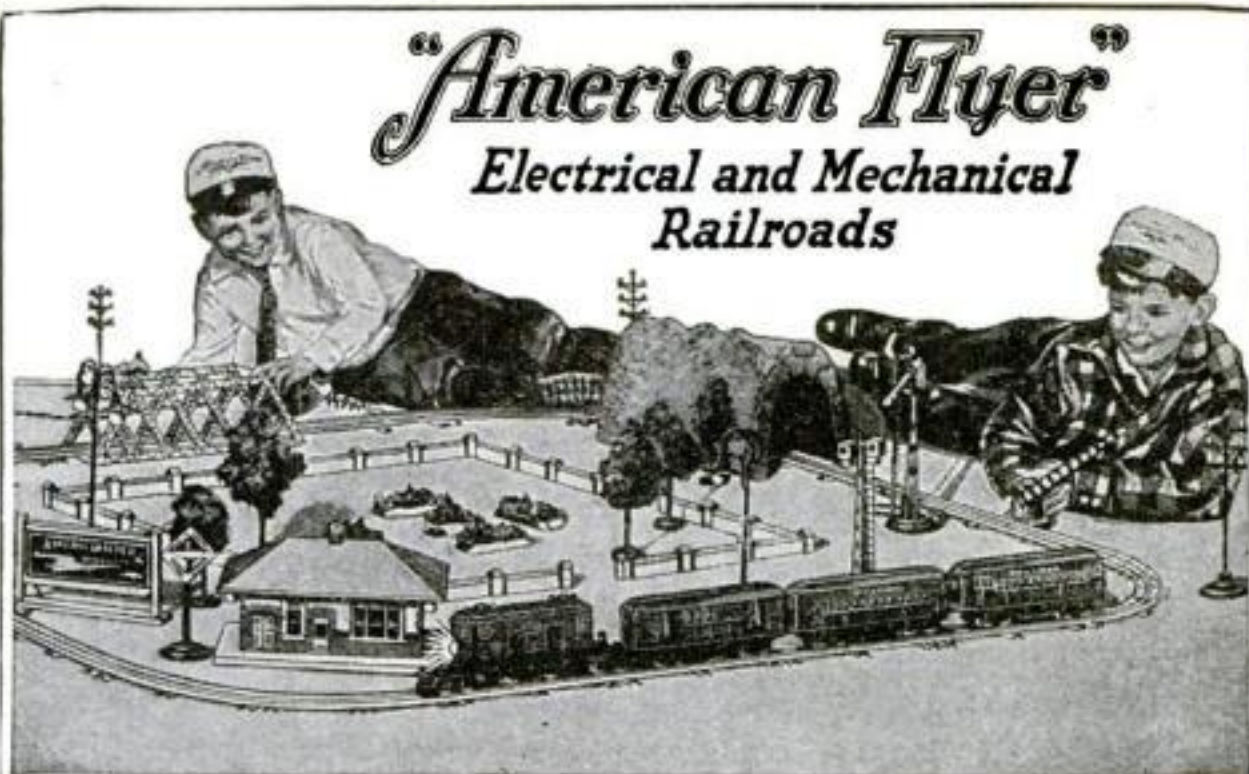
Insulated by a piece of wood, a metal arm rises above the shaft. To this arm is fastened a wire so that it makes and breaks contact with the bolts as they pass by. The remaining pole of the battery is connected with this arm.

The current flows through the magnets when the iron bar is just above them; but when the bar is in line with the magnets, the current is broken. Momentum turns the shaft past the dead point and contact is again made between the wire and the next bolt-head. This allows the current to flow through the magnets and they attract the next bar. The current flows only for an instant or so, just long enough to attract the nearest iron bar, whereupon it breaks until the next bar is attracted. Any battery or door-bell or toy transformer giving six volts will run this little motor.—E. B.

Cork Tips Prevent Chair Legs from Scratching Floor

CORK tips on chair legs will protect varnished or waxed floors from unsightly scratches. At the same time the corks make the chair relatively noiseless.

To attach the corks, bore a hole $\frac{1}{2}$ in. deep in the bottom of each chair leg. Fit into the hole either an ordinary bottle cork or a rubber stopper, allowing it to project $\frac{1}{4}$ in. or more. One set of corks will last many months and when they are worn down, it is a simple matter to replace them.—K. B. M.



TRAIN ILLUSTRATED ABOVE

No. 1307—*Twentieth Century Limited*—exact copy N. Y. C. Electric Locomotive with headlight and automatic reverse, mail car—2 Pullmans—all electric lighted—20 pieces of track. Length of train 48 inches—track 202 inches. Price, delivered, \$26.00

The World's Fastest Train!

THERE it goes! WOW—What a pick-up!! "Hey slow it down Bill—there's a curve ahead!" shouts Pinkey the new American Flyer fireman. Bill doesn't move—the American Flyer roars on—hits the curve gaining speed all the time—its again on the straightaway speeding and roaring towards the first stop.

"Stop it Bill! We pick up the mail here," cries Pinkey as he looked anxiously ahead.

"All right Pink."

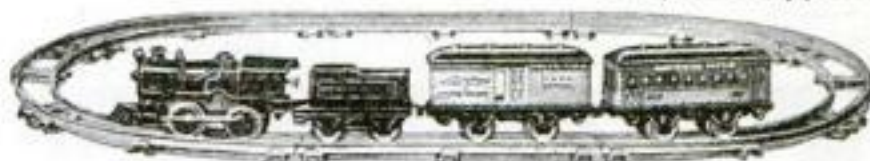
Bill the Engineer figures just where he wants to stop in order to pick up the mail—he shuts off the power—the American Flyer slows down and comes to a dead stop without the slightest sign of a jar or shake.



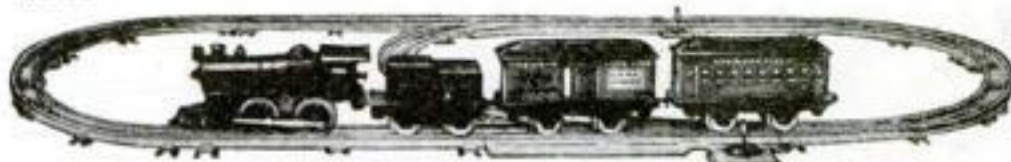
No. 1221—Electric Engine, with headlight, 8 inches; 3 double-truck cars, $6\frac{1}{2}$ inches, 14 pieces of track, semaphore, station, tunnel; rheostat and track connection. Length of train, 31 inches. Price, delivered, \$12.00



American Flyer Transformer
Price, delivered \$3.75



No. 2—Mechanical Engine, with brake and piston rods $6\frac{1}{2}$ inches, tender 4 inches, cars $5\frac{1}{2}$ inches; baggage car has sliding doors; 10 pieces of track, 103 inches; length of train, $24\frac{1}{2}$ inches. Price, delivered, \$2.65



No. 13—Mechanical Engine, with brake and piston rods 7 inches, tender 4 inches, cars $5\frac{1}{2}$ inches, baggage car has sliding doors; 12 pieces of track, 2 switches, length of track, 160 inches; length of train, 25 inches. Price, delivered, \$4.25

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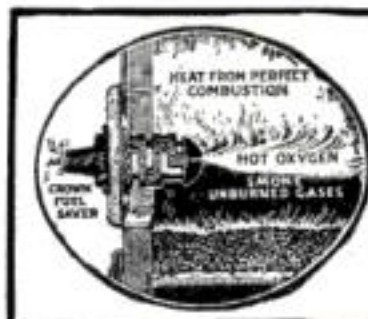
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the feed
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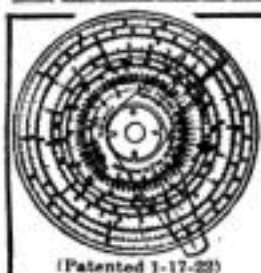
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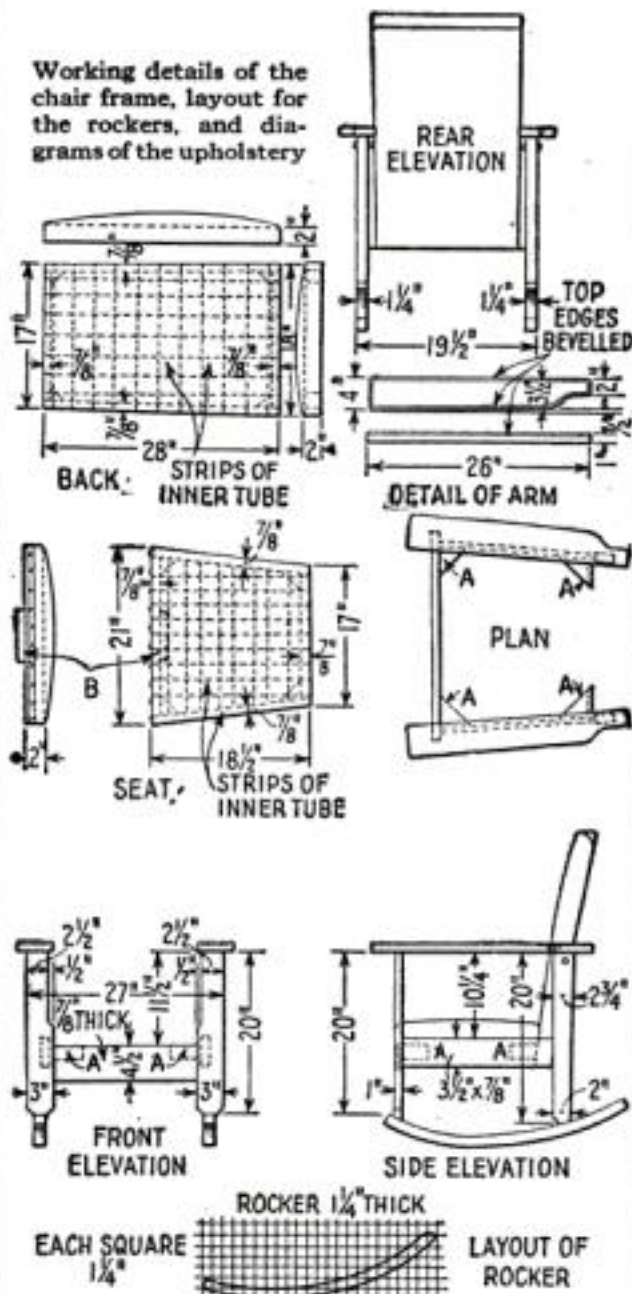
The completed rocker

because of its ease of construction; and, besides, it is a most comfortable chair for the smoking-room, den, library, or living-room.

The rocker is built preferably of oak. The four legs are cut from 1-in. stock to the dimensions shown. They are mortised and tenoned to accommodate the arm rests, side rails and rockers.

The arm rests, also cut from 1-in. material, are mortised to take the tenons on

Working details of the chair frame, layout for the rockers, and diagrams of the upholstery



the legs. The upper edges of the arm rests are beveled.

The three rails that connect the legs are dressed to 3/8 in. and tenoned to suit the mortises in the legs. The rockers are cut from 1 1/4-in. stock.

When these parts have been prepared, they should be well sanded and assembled with a good grade of liquid glue. Set aside to harden thoroughly.

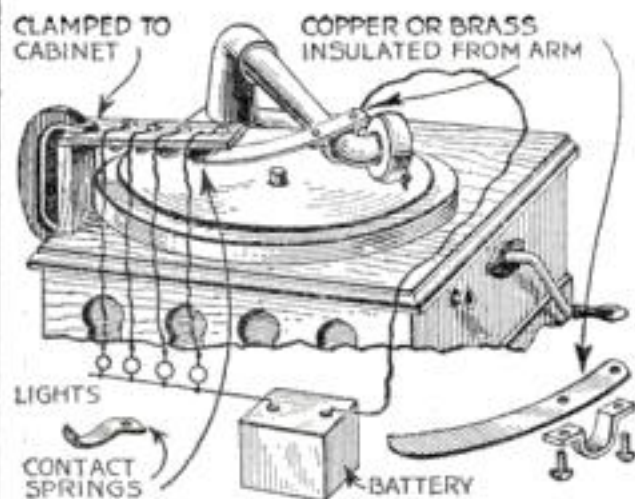
(Continued on page 149)

Phonograph Turns on Lights to Music of Carols

By R. H. Kasper

AT CHRISTMAS any novelty appropriate to the season is enjoyed by the whole family, from the little children to the grown-ups. If one has a Christmas village, and a phonograph is available, a novel light effect can be produced with very little work.

The village is set up, the houses are equipped with low-voltage electric lights, and the phonograph is arranged as illustrated to switch on the lights auto-



How the contact pieces are attached to the phonograph, and diagram of the wiring

matically, one after another, to the accompaniment of a Christmas carol, such as "Silent Night! Holy Night!"

An arm made of copper is clamped to the swinging tone arm of the phonograph, but insulated from it. Directly opposite the copper arm, a piece of wood is clamped to the cabinet so that there will be about $\frac{1}{4}$ in. clearance between it and the copper strip. This piece of wood carries a number of contact shoes, one for each light used. These are bolted to the wood and connected by wires with the lights.

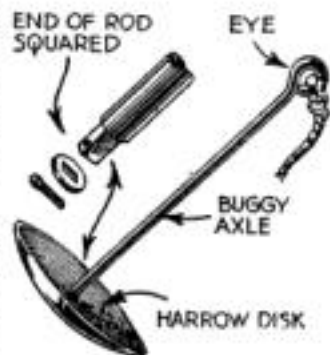
As the swinging arm of the phonograph passes across the Christmas record, one contact after another is formed, flashing on the corresponding lights.

The contacts must be very light, so as not to hinder the movement of the reproducer across the record. The wiring is as shown; one side of the lights is connected with a common wire, which goes to the battery, and the other wire from the battery is connected with the contact on the tone arm of the phonograph.

Small Mushroom Anchor Made from Old Harrow Disk

A MUSHROOM anchor for a rowboat or raft may be made from an old harrow disk. A simple way to form the shank is to heat one end of an old buggy axle or similar steel or iron rod and bend an eye for the anchor rope. The other end should be squared and fitted in the square hole in the disk.

The disk bears against a shoulder on the end of the rod and a washer and large cotter hold it securely.



For a rowboat or a small raft

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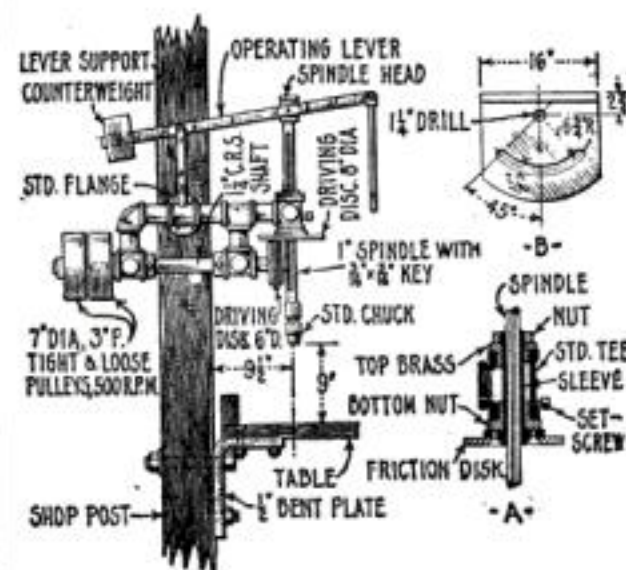
Post Boring Machine Built Largely of Pipe Fittings

By Frank N. Coakley

PERHAPS the easiest machine for the home workshop mechanic or the carpenter to make is the post borer illustrated. It is constructed from materials that are readily obtained. As the frame is made from 2½- or 3-in. pipe and pipe fittings, the expense of constructing patterns is unnecessary.

The driving shaft is made from a short length of 1¼ in. cold-rolled steel. Keyways are cut at each end, one for the tight pulley and the other for the friction disk. The two tees that act as bearings are babbitted to the shaft size and a hole tapped in the side wall of each for a grease cup. Two collars are setscrewed securely to the shaft in the positions shown.

To form a support for the bearings, a standard pipe flange is screwed to a short length of pipe, which is screwed into a tee between the two bearings. This tee is provided with a tapped hole for a 1-in. pipe, which is flattened to receive the lever



A side view of the boring machine and details of friction disk and table bracket

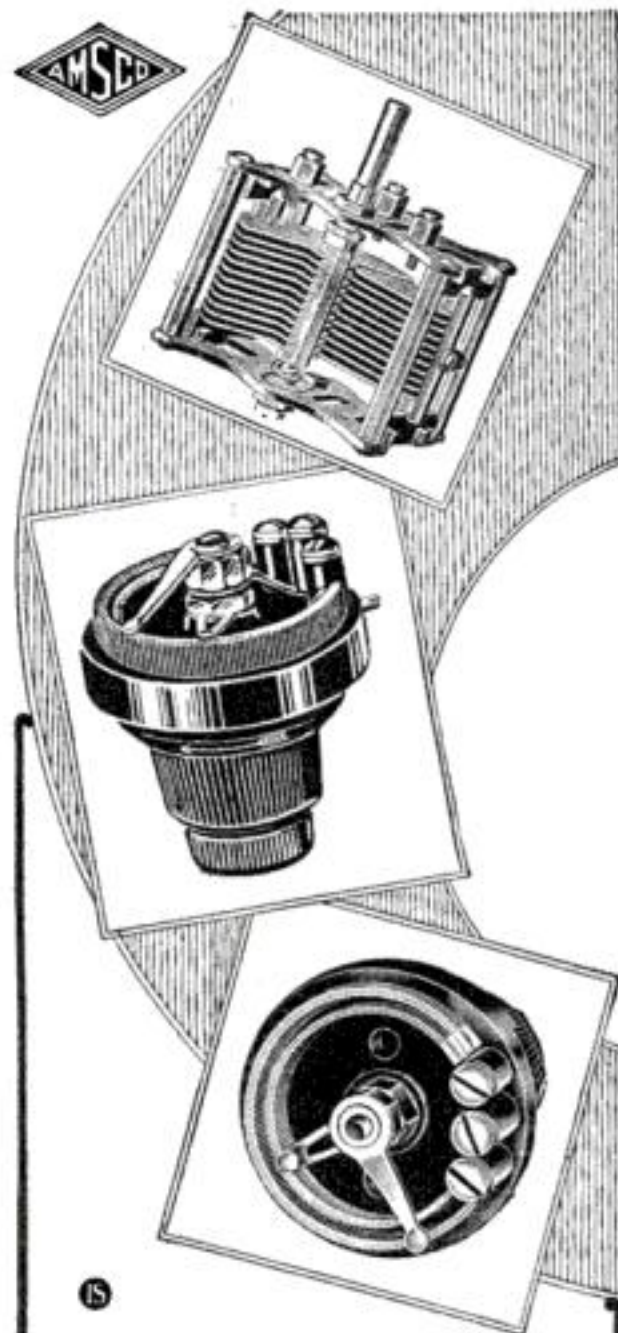
support. The lever support and operating lever are from 1 by ¾ in. flat steel bars, riveted together. A pull rod is hung from the end.

The spindle is a piece of 1-in. cold-rolled steel, keyed as shown.

The machine is provided with a friction drive. The driving disk is made from 2 round plates between which 3 fiber disks are clamped securely. These are trued up in a lathe. The driven or spindle disk is a piece of ¼-in. plate, perfectly flat and smooth, fastened to a sleeve, as in the detail A. The bottom nut is provided with pinholes to allow for adjustments to keep the two disks tight together. The side of the tee at this point also is tapped for a grease cup. A ¼-in. hole is drilled in the disk sleeve to allow grease to lubricate the spindle. It is a good plan to plug the pipe leading into this tee so as to keep the grease around the moving parts.

The table is so simple that it requires little explanation. The bent plate that acts as a bracket is provided with a circular slotted hole to allow the table to be tilted for angular drilling. This feature is shown at B. A wooden bench is fastened to this plate.

Care must be taken to make all the pipe connections perfectly tight.



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Combination rheostat and Potentiometer. Selected by L. M. Cockaday for use in his improved Four Circuit Tuner, as described in the October Popular Radio.

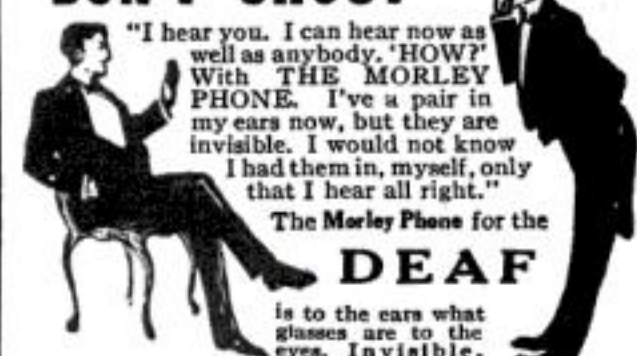
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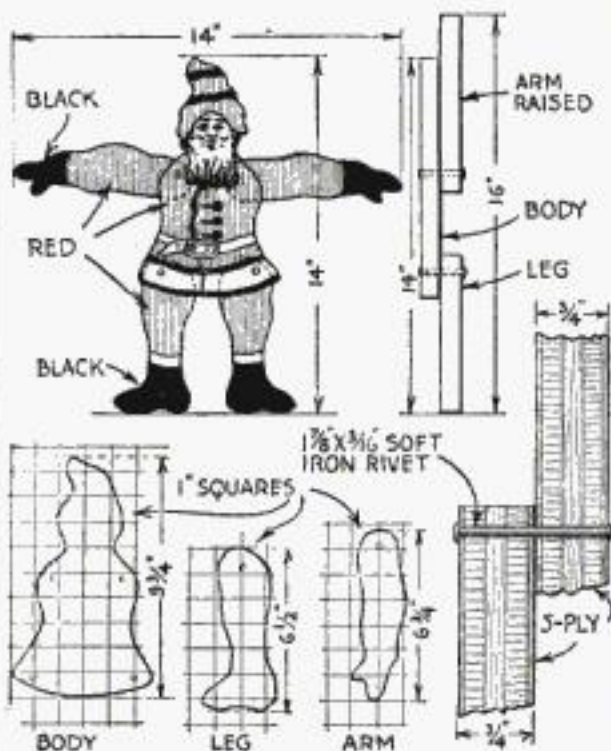
Making Durable Christmas Toys of Heavy Plywood

By Capt. Charles C. Hall

EACH of my four children has one of the Santa Claus dolls illustrated and I have made others for nearly every kiddie in the neighborhood. Four years ago I made 14 of them and, except for some scratches, they are as good today as when made, and as well loved as any dolls.

The durability of these toys is due to the material of which they are constructed, which is 5-ply veneer $\frac{3}{4}$ in. thick. Five- or 3-ply veneer $\frac{1}{2}$ in. thick is more generally stocked by lumber dealers and it will do about as well. It is not advisable to use ordinary straight-grained wood, as it is apt to split.

A piece of veneer 12 in. square will be sufficient to cut out one doll. By dividing



The Santa Claus doll, detail of the joints, and squared patterns of the parts

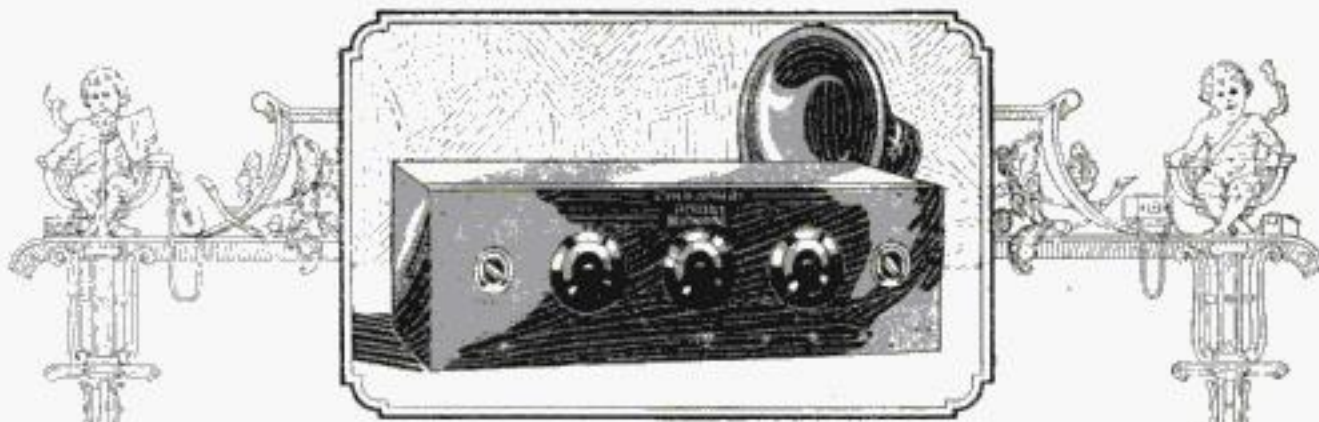
a sheet of cardboard into 1-in. squares and copying the patterns, it is a simple matter to make templets for marking the wood. Naturally, the arms and legs are rights and lefts, but this is taken care of simply by turning over the templets. I use a bandsaw in cutting out the wood, but a coping saw will do.

A $\frac{3}{16}$ -in. hole is drilled in the center of each arm and leg $\frac{1}{2}$ in. from the end that fastens to the body. A corresponding hole is drilled in each shoulder and hip. If $\frac{3}{4}$ -in. veneer is used, four $\frac{3}{16}$ by $1\frac{1}{8}$ in. soft iron rivets will be needed. The rivets are driven through from the front and riveted in the back.

I have found that white, black, and red carriage paint gives the best results in finishing these toys, as it dries quickly and leaves a gloss. The expression of the face is helped if a touch of blue is given to the eyes. The lips and end of the nose are red. The remainder of the coloring is indicated in the diagram.

Waxing Woodwork Successfully

WHEN amateur woodworkers have trouble in obtaining a good wax polish, usually it is because they overlook the fact that a good waxed surface is insured only by the friction caused by hard and long continued rubbing.



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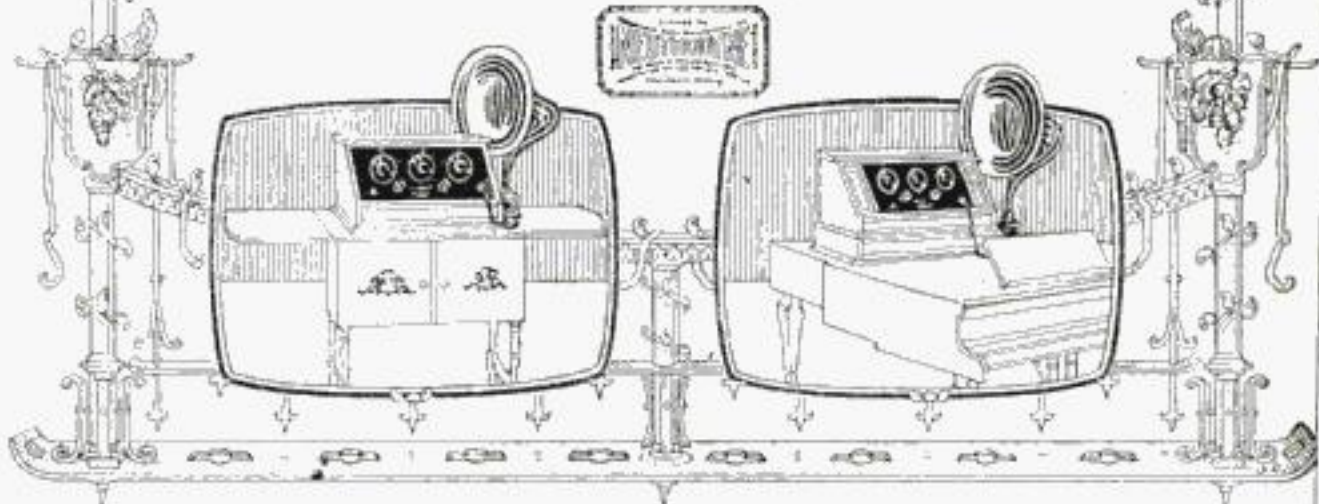
If your dealer does not handle Thompson radio products, write to us for descriptive literature and the name of a Thompson dealer near you.

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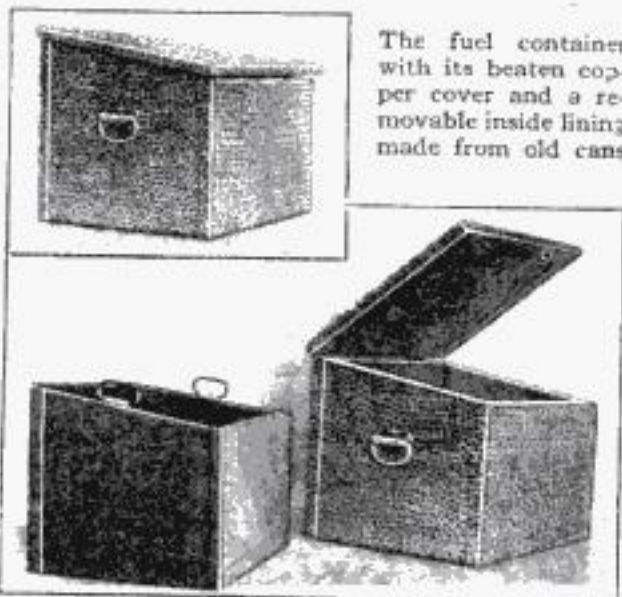
FERRY & CO., 3224 N. Halsted St., Dept. 9789, CHICAGO

Building a Hammered Copper Wood Box for Your Fireplace

By H. Caldwell

COVERED with hammered copper, this coal-and-wood box is at once a convenient and an attractive accessory for the fireplace. The richly colored metal catches the glow and light of the fire. The box is very easy to make, as only simple butt joints are required. It may be of $\frac{3}{4}$ -in. pine, spruce or any wood at hand. The front is 11 by 18 in., the back, 14 by 18 in. The two sides are 13 in. wide, 11 in. high at the front, and 14 in. at the rear. The bottom is 13 by 16 $\frac{1}{4}$ in.; the top 15 $\frac{1}{2}$ by 19 in. This allows for the top to project $\frac{1}{2}$ in. on the sides and 1 in. in front.

The copper should be about 30 gage, cut large enough to turn 1 in. inside the box and 1 in. on the bottom. The sides turn 1 in. at the back, but are flush with the front at the front corners. These corners are bound with copper, for which two



The fuel container with its beaten copper cover and a removable inside lining made from old cans

strips 2 by 16 in. are required. They are bent at right angles after being scored slightly to insure a sharp bend.

The hammering tool is made from a piece of bar iron $\frac{3}{8}$ in. in diameter and 8 in. long. It is rounded off and polished at one end. The copper is placed on a piece of hard wood and the tool driven against it sharply with a hammer. This causes a dent, which may be made as light or heavy as fancy dictates. A conventional design may be traced and hammered if desired, otherwise the copper is covered irregularly with the indentations.

When hammered and straightened, the copper is nailed on the box with copper nails. The top is put on with 1 by 6 in. strap hinges and two handles are placed on the sides.

The box next should be washed with a strong solution of hot water and sal soda. Apply with a swab a solution of one tablespoon of liver of sulphur to a quart of water. This will darken the copper all over. Rub the box with a piece of hard felt dipped in wet powdered pumice to brighten the high spots and leave the rest dark. Wipe off any excess powder and give the copper a coat of lacquer.

Put 4 furniture slides or, if preferred, copper feet on the bottom, and paint the inside and back with black paint.

A lining may be made if desired, from two 5-gal. shingle-stain cans, or other old cans, which also will provide the handles.



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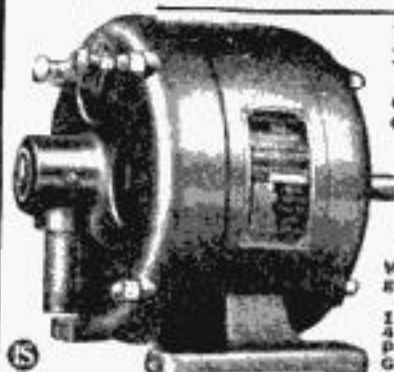
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including cord, plug, pulley and belt, everything complete, ready to attach. The saw furnished with this outfit is the Daston 6" Novelty Combination Cross Cut and Rip Saw, guaranteed to run without set. No planing or sanding required after cutting. This saw is equipped with extra heavy duty motor guaranteed to handle 50% overload.

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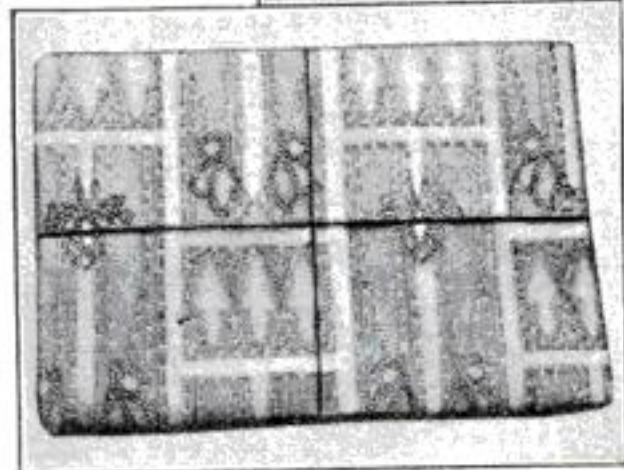
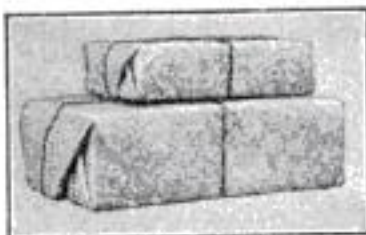
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of expensive parchment wrappers for presents, which of late years has been used by those persons who were able to afford it.

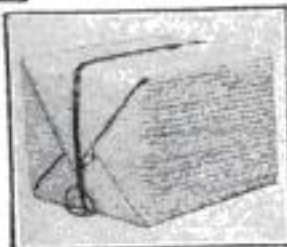
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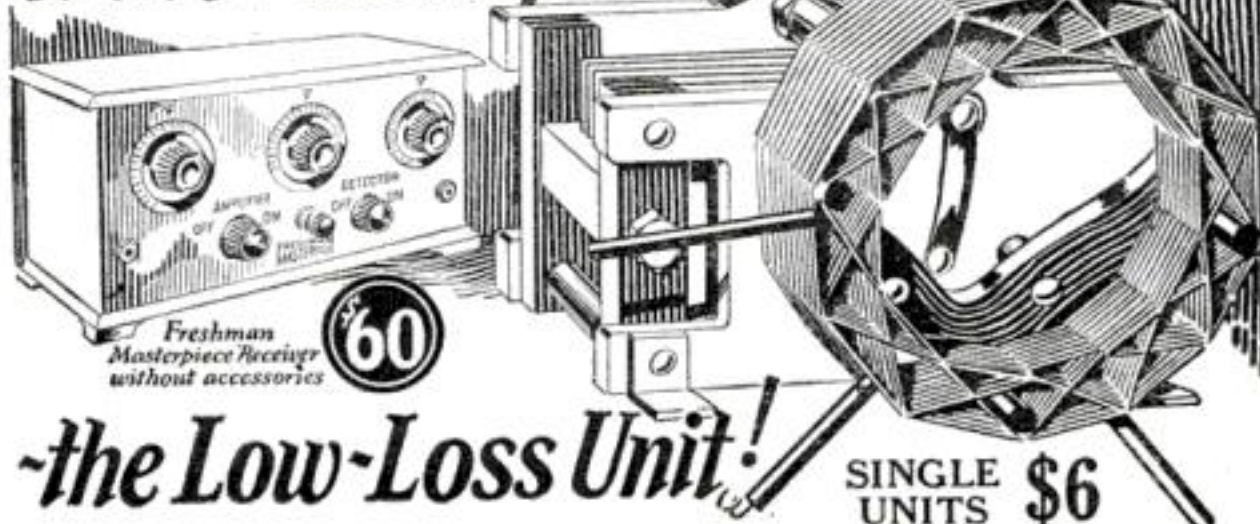


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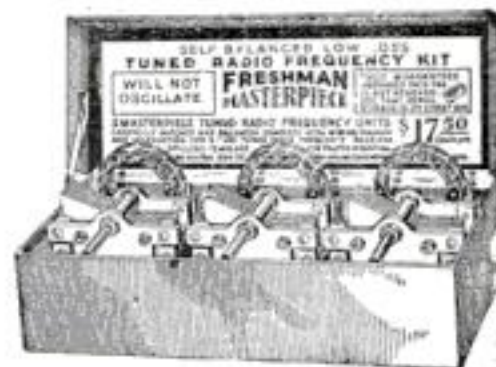
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Free Discoverer's Book

If you suffer with any of the distressing conditions mentioned above, you should not lose a day in finding out the full details of this wonderful treatment. Every man past 40—in fact every man in his late 30's, should learn how, by this method, he can treat himself at home and prevent these distressing conditions. The scientist who discovered this method has written an interesting book entitled "Why Many Men are Old at 40," which will be sent you free, upon request. It comes in plain wrapper. It contains information that may be invaluable to you. Simply drop a letter or postcard to The Electro Thermal Company, 4040 Main Street, Steubenville, Ohio, the concern that is distributing these books for the author. Or you may send your request to the Western Office, addressing The Electro Thermal Company, Dept. 40-E, 711 Van Nuys Bldg., Los Angeles, Calif. But hurry, for the edition of these books is limited.



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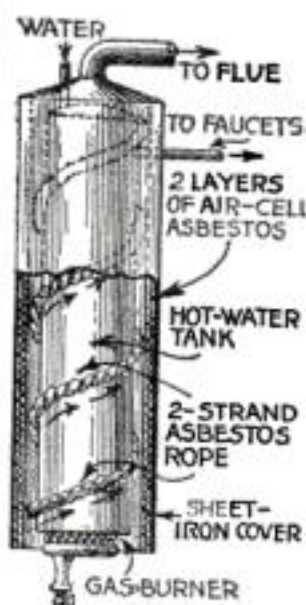
"Had about given up hope when doctor recommended your treatment. Can say I am cured of the awful trouble. My age is 73 young."—H. B. Ruth, Colorado Springs, Ohio.



"Had trouble with my Prostate Gland for five years. Sent for Electro Thermal Treatment and about the third treatment felt much better. Can recommend your treatment to anyone afflicted as I was."—D. W. Cornett, Pittsburgh, Penna.

How to Heat Hot Water with Half the Gas

IN A comprehensive examination of thousands of hot-water heating installations made by the writer, it was found that hundreds of tanks were heated by means of a burner placed directly under the bottom of the tank. This, of course, is a gas-wasting method. Nevertheless, this system can be made to operate efficiently if a jacket composed of two layers of air-cell corrugated asbestos paper is applied. Do not use plain asbestos paper.



Hot air 'passes' spirally over the tank

Contrary to the method of jacketing systems employing a coil heater, the asbestos paper must not touch the tank. A separator made by twisting two strands of $\frac{1}{2}$ -in. asbestos packing rope together, is wrapped securely around the tank as shown. The jacketing then is applied. This leaves an air space of from $\frac{1}{2}$ to 1 in. between the tank and jacket.

The separator guides the extremely hot burnt gases spirally over the entire surface of the tank. A gas meter connected with the gas supply feeding the tank burner before and after the jacket installation proved that slightly more than half the gas formerly used makes possible the production of all the hot water needed.

The outside cover is made from ordinary sheet iron and need not be covered with asbestos. Note that the bottom of the jacket should just hide the burner flame.

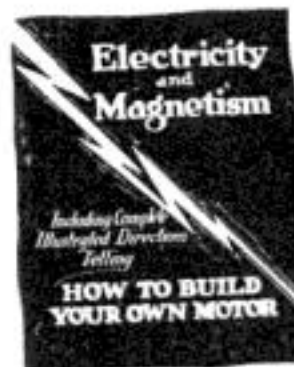
The best results are had when the burner flame is non-luminous, that is, when the flame is of a faint reddish blue color and without a trace of yellow or orange.—JOHN H. SCHALEK.

Spreading Liquid Glue Quickly over Large Surfaces

SPREADING liquid glue over large surfaces, as for gluing maps or large sheets of paper, it is often difficult to distribute it quickly enough to prevent part of the surface drying before all is covered.

A good way to get a quick and even distribution of the glue is to punch two small holes with a tenpenny nail, one opposite the other in the top of the can. By partly inverting the can without removing the lid, allow the glue to run out in a small stream and distribute it evenly over the surface in lines an inch or two apart. This insures even distribution over the whole surface and the glue then may be spread very quickly with a stiff brush. Warming the glue by setting the can in hot water for a few minutes will insure its running freely.

To close the holes after using, simply stick a small patch of paper over them.—M. W. LOWRY, Athena, Ga.



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"Then the Lion Fell Dead"

(Continued from page 39)

lurks in the bush, never attacking until he has to as a last resort. Klein agreed that the lion rarely will attack a man first.

"A lion isn't a coward," he said, "but he plays his own game. Perhaps he is lying in a cool place in a piece of brush and sees you go by. If he thinks you haven't noticed him, he'll watch you and never say 'boo.' But if he thinks he is observed, he'll run off to the nearest shelter. You follow him and he'll run again. He will do this once or twice, then he will come for you."

"USUALLY a lioness will jump out of her ambush as soon as she hears you coming and roar to let you know that she will defy you. But once we were right at the entrance to a den when the lioness leaped at us. There was nothing to do but kill her. We took the three cubs, whose eyes were just open, back to camp with us, and raised them until they were about two feet high."

Big game is disappearing in Africa. The natives are to blame for this, said Klein, for in spite of the laws prohibiting it, they massacre the animals in great game drives. Klein is the only white man who ever has witnessed and photographed one of these native game raids.

"One evening in the twilight," he said, "I went up on a mountain called Benagie with a native, to look for lions coming out of their lairs. If I could locate a lion den in the evening, I would know just where to hunt the next day. Lions, like all other game in the jungle, come out only in the early morning and in the evening."

"I saw a lot of natives running, and before them were zebras, giraffes, elands and other game. I pointed them out to my servant, who said, 'Oh, master, they're trailing the game. Watch for their camp.'"

"I located the spot where they seemed to stop, but it was too late then to do anything; the place was too distant. At daybreak next morning, I was in my saddle, and with 15 natives rode to the spot. We caught the natives in the thick of the killing part of the drive. They were skinning the animals, while their wives and children were cutting the meat in strips and drying it over fires, getting ready to carry it back to their homes, two days' march away."

"THEY grabbed their spears. I convinced them, however, that I was not a government official, and they allowed me to take pictures of them in the pits. They had no fear of the camera. Some tribes have, connecting the camera with the 'Great Evil Eye,' but these natives belonged to an extremely primitive tribe, incapable of forming an association of ideas like that."

"Preparing for a big-game drive, the natives dig 32 rectangular pits about eight feet deep, arranged in the form of a V, with one pit in the first row, three in the second, five in the next, and so on. The dirt taken from the pits is thrown back of the last and widest row, making an

(Continued on page 158)

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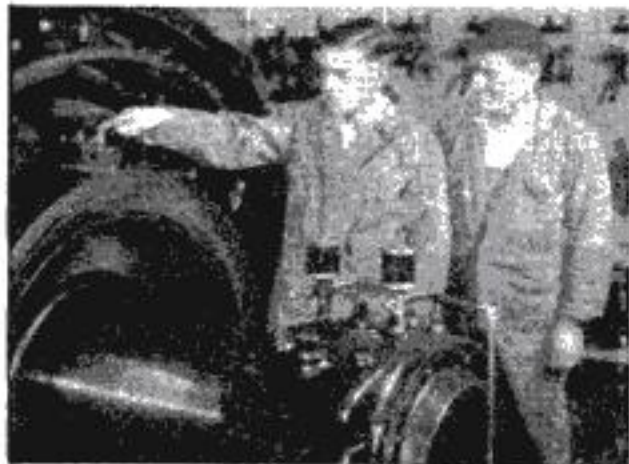
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"Then the Lion Fell Dead"

(Continued from page 157)

embankment. The holes are covered with light shrubs, sticks and straw. On each side of the V, extending for a long way, a barrier of heavy thorn bush is erected. Then the natives go out and round up the game.

"They start out in the early morning and arrive at the pits at nightfall, driving the game before them. They close in, so that the beasts have to go between the thorn-bush fences toward the pits. At last the hunted animals are on top of the embankment. The hunters come closer. Then giving one last desperate leap, the animals jump forward and fall in the pits, where their legs are broken and they are crushed one against another. The natives then rush in with spears and poisoned arrows and kill the mangled beasts.

"IN THE pits I saw, there were 52 animals, including four giraffes, five elands, a gnu, a hartebeest (a big antelope), a beautiful gazelle, a zebra, and even a rabbit. It was the worst massacre of wild animals I ever have seen."

There are dangers lurking everywhere in the jungle, Klein declared. A man may go to sleep peacefully beside his campfire, and the next day his body will be found beside the dying coals, a poisoned arrow through his breast. Vengeful savages attack stealthily, and usually no one ever knows who committed the crime. Once Klein had a chance to solve a murder mystery of this sort.

"We were out after lions," he said, "and were camping one night beside a swollen river. On the opposite bank we noticed four natives who were driving eight cattle and some goats. During the night a raiding party of natives came and with poisoned arrows killed three of the men as they slept. The fourth, a boy, escaped, and climbed a tree.

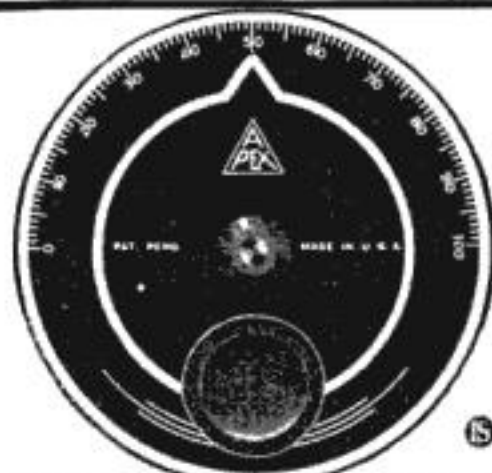
"At daybreak, the boy, hearing the noise of our dogs and chickens across the river, called out to us for help. I got into my canoe and shot across the stream. In an instant I saw what had happened.

"I FOUND 19 arrows. The natives all have their arrows marked with personal identification signs, so that when several shoot at an animal, the one who makes the hit can prove it is his. I sent a boy with two arrows to the district commissioners. They held a court and found the man who had made the weapons. Through them the owners of the arrows were found and, later, hanged."

Courage and patience are the qualities that Klein considers most essential for the big-game hunter, especially for the hunter of lions. To make sure of killing a lion, he says, you must wait until he is within six or seven feet of your face.

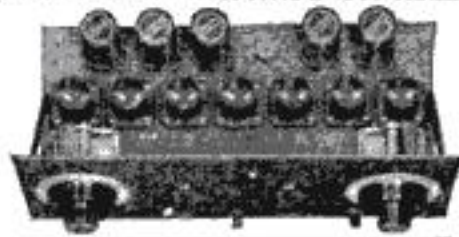
A lion is tearing at you! Only 10 feet away! Pull the trigger then and you may be a dead man. If you can wait an instant longer, you are safe. That instant is the supreme test.

Klein could meet it, and that is one reason why today he is able to tell his remarkable story.



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Power for Everybody

(Continued from page 55)

eminent power engineers of the world to get behind the project of tapping the internal heat of the earth as an undertaking "important enough, both scientifically and economically, to justify its being made the subject of an international co-operative enterprise."

"The cost of such an experiment," said Mr. Rice, "would be trivial compared with the value of the possible information that might be gained by the investigation of this unexplored region of the earth. If only the people and their representatives had the faith and vision of science, the value of such an idea would have been put to practical test long ago."

And it is of record that more than 200 internationally famous engineers who heard Mr. Rice and more than 100 who heard Sir Charles Parsons, in each case offered unqualified approval of this revolutionary idea.

MOREOVER, the United States Government has taken the initiative, among all the nations in the world, of investigating the possibilities of the idea on a large scale. In the crater and on the slopes of Mount Kilauea, the famous Hawaiian volcano, a party of government volcanologists recently started drilling to study the changes in temperature that occur toward the center of the earth, to obtain new knowledge of mineral and gas changes beneath the ground, and to determine scientifically how the heat of the earth's interior may best be utilized for power purposes.

For some years, too, engineers in Italy have been utilizing the steam from the boiling springs of volcanic regions to operate engines.

Only recently at Healdsburg, Calif., 75 miles north of San Francisco, engineers drilled 300 feet into the ground to tap a great supply of natural steam lying beneath 4000 acres of volcanic land. This project is nearing completion, and the engineers in charge say that the power from their natural steam boiler, when suitably harnessed, will be sufficient to light and heat San Francisco and run every factory in the vicinity!

SO MUCH, then, for the feasibility of a scheme such as Sir Charles Parsons suggests. What, though, does it offer us in the way of practical possibilities?

It is unlikely that the average person realizes just what a tremendous bearing power has on his daily activities, and yet a considerable portion—as much as 50 per cent possibly—of every dollar we spend goes for power.

Our clothes are made by power-driven machinery from wool that has been spun and woven and dyed in factories that need power. Our furniture is sawed and shaped and polished by power. Power lights our homes, our shops and our offices. Power transports us back and forth to our jobs. Power goes into the materials that compose our homes.

Even the rawest food represents power, in transportation, in the mechanical sowing or harvest, or in all of these.

(Continued on page 160)

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Power for Everybody

(Continued from page 159)

There is virtually nothing that we can buy, the cost of which does not include the price of steam or electricity.

In fact, we may truthfully say that our modern civilization rests entirely on the use of power, most of which is made by steam boilers that use coal. Merely to carry on our daily activities we need about 100,000,000 horsepower, an amount that, without our modern mechanical appliances, could scarcely be furnished by 4,000,000,000 men, or more than twice the present population of the globe. Without coal, in short, our civilization would collapse in a week.

Now, eliminating the possibility, often suggested by scientists, that our two principal sources of power—coal and oil—eventually will be exhausted, the benefits that would accrue to mankind were the power shaft conceived by Sir Charles Parsons to be constructed, ought to be apparent.

TO BEGIN with, such a source of heat, once the initial cost was paid, would supply power at one-tenth to one-twentieth what it costs now to derive power from coal. And that would mean, for example, that we could cut our railway and ocean freight rates in half at least. It would mean that we could heat our houses all winter for what one ton of coal costs now.

Iron, cement, and other building materials could be produced so cheaply that rents could be reduced to a level never before known. Ten-dollar shoes would cost no more than five or six dollars. A \$50 suit could be bought for \$25 or \$30.

A \$1000 automobile according to the present scale of prices would give its manufacturer a generous profit if sold for \$600 or \$700. We could count on the buying power of our dollar being increased to a dollar and seventy-five cents or two dollars. We could irrigate the great deserts—places such as the Sahara and Death Valley—and treble the food supply of the world.

Nor are the possibilities suggested here merely idle speculations. They are based on the estimates of foremost engineers, economists, and agriculturists, arrived at by calculating how much power is imprisoned in the earth's hot interior. Their figures are staggering. Expressed in numerals they convey no clear idea to the mind.

IT IS futile, for example, to attempt to appreciate the magnitude of such a number as 200 million million million—the heat of the earth, scientists say expressed in terms of tons of coal. But we do understand when science tells us that this heat is infinitely more than mankind will require to supply all possible needs for power and fuel until the end of time. One shaft, of course, would not make this entire supply available at once. But one shaft would point the way to others and thus the power problem of the world would be solved.

The future of man is in safe hands. Science today is marching as a valiant vanguard, smoothing the way for the coming generations of the earth.

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A Garage to Fit Your Car

(Continued from page 87)

The floor should be constructed of cinders or broken stone from six to 10 inches deep, covered with from three to four inches of concrete, consisting of one part Portland cement, three parts sharp bank sand, and five parts clean boiler cinders or crushed stone. The surface of this should be graded to a pitch of two inches in 10 feet to a floor drain immediately under each car. The surface of the concrete should be dressed, before setting, with Portland cement and sand mortar in the proportion of one to two.

A garage of this type may be of almost any kind of construction—shingle, siding, metal lath, with stucco, hollow tile, concrete block, brick—depending on your inclination, the architecture of your home, and the amount of money you wish to spend. Such a variety is possible that the cost of construction may range between a few hundred dollars and several thousand.

METAL lath carried all the way up on both sides of the stud frame of the wall and plastered inside and out with Portland cement stucco, with a ceiling of like construction and a fire-resistant roof, will give a semi-fireproof construction that will be passed by most fire or building departments and result in lower insurance rates. Fireproof sash for door and window construction will further safeguard a building of this type.

Or you may have completely fireproof construction—concrete block, hollow tile, concrete, brick, or stone walls, with roof of reinforced concrete, combined reinforced concrete with hollow tile, or ribbed metal lath and concrete, finished with tar and felt, slate, asbestos shingles, ribbed metal, or clay tiles. Such a building takes the lowest insurance rate, and, if near your home or other buildings, is likely to cause reduction of the insurance rates on them.

GARAGES built into dwellings recently have become popular. It is almost needless to say that a garage of this type should be fireproof, or at least semi-fireproof. In many places the former kind of construction is obligatory. The built-in garage, properly safeguarded, probably is the best of all. It is convenient, it can be heated from the house plant, it can be electrically wired easily, and, when constructed at the same time as the house, is the most economical kind of garage to build, especially if the house is on a terrace, has a high basement, or stands on land graded so as to permit you to make the garage part of the cellar.

Because such a garage is easy to reach and pleasant to work in, the car that occupies it probably will receive more care than the car housed in a detached garage. This means longer car life and less expense for upkeep.

The twin dangers of the built-in garage—which, however, may exist in any garage—are gasoline fumes that collect along the floor, and carbon monoxide from the exhaust. These may be eliminated by proper ventilation and an automatically

(Continued on page 162)

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A Garage to Fit Your Car

(Continued from page 161)

closing fireproof door at the house entrance.

In many parts of the United States it is unnecessary to supply a garage with heat. Alcohol, patent compounds, or draining the radiator will prevent freezing. A heating plant in the garage needs frequent attention and is likely to be neglected. All things considered, the best plan is to carry a heating line and return line from the house to the garage through a trench, the depth of which will depend on the climate.

If a heating plant is installed in the garage, it should be in an entirely separate room, with no connecting door and with a floor two feet higher than the garage floor. Any kind of open heater—gas, oil, or coal stove—is dangerous in a garage because of the gasoline fumes that almost constantly are drifting along the floor.

THERE are many other features of garage construction that space will not permit me to discuss. Such items as the kind of hardware to be used, for example, will demand careful attention when the time arrives for you to build. Local conditions of various kinds—the cost of materials and labor, fire-department regulations, the type of surrounding buildings—all will have considerable bearing on the sort of garage you build. Your garage is an individual problem, and no one can help you to solve it better than your local architect.

Recent Publications

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Elements of Electrical Engineering, by George D. Shepardson, A.M., M.E., Sc.D., professor of electrical engineering, University of Minnesota. The Macmillan Company.

Handbook of Direct Currents, by K. C. Graham. One of the "Railwaymen's Handbook Series." Simmons-Boardman Publishing Company.

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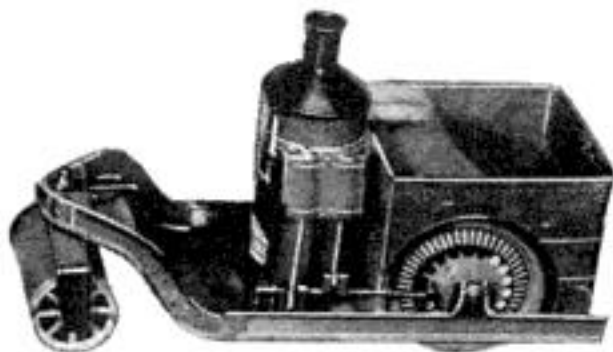
What I Have Learned about Toys and Men

(Continued from page 43)

leaders. Suppose there were 100 men, and the one in command was killed. There was another who could take his place, and in some instances, still a third who could command. But after that there was chaos. Most of the other 97 were trained automatons and nothing more. The whole formation went to pieces.

Now take 100 men in an American company. If the leader was shot, there always was another to replace him, another after him, and another after him, and another after him—volunteers down to the last five men. They had learned to lead as playing children.

The toy educates the child. So says the psychologist from his learned tests,



A new toy mechanical street-roller that is driven by a real miniature steam-engine

and so say I from observation and experience. How does it do so?

First, by giving the child accurate images. It is extremely important that a child get a correct idea of things. The first impression in the brain cells is very likely to be the deepest. The toy should be as nearly an exact imitation of the real thing as possible. The toy that isn't designed right is a very bad thing. A child is given an engine. If it is an exact imitation, the child will remember it as an accurate engine for the rest of his life. But if it is a poor imitation, he will remember it as a poor engine just as long.

Children, through mechanical toys, are keeping pace with progress and the times, as witness the mechanical Mail Plane and the Yell-O-Taxi. The child, through the medium of play, is unconsciously absorbing knowledge of the important events going on around him. He may not understand why mail is being delivered by airplane, but he knows it's being done.

When you are giving a child a toy, give him something good. If it is a wagon, get him one that will stick together for five years. If it is a tool, get him one made out of good steel. A boy who has learned to love the feel of tools in his little woodshed workshop will keep that love throughout his lifetime, and as he grows older, he will want the best planes, the best hammers, and the best chisels that money can buy, a desire that leads to economy and efficiency. If a child is disgusted with a toy, he will not be disposed to care for the real article that the toy imitates.

One of the best ways to eliminate fear in a child is through toys.

You have seen small children who have hung back terrified when confronted by

(Continued on page 164)

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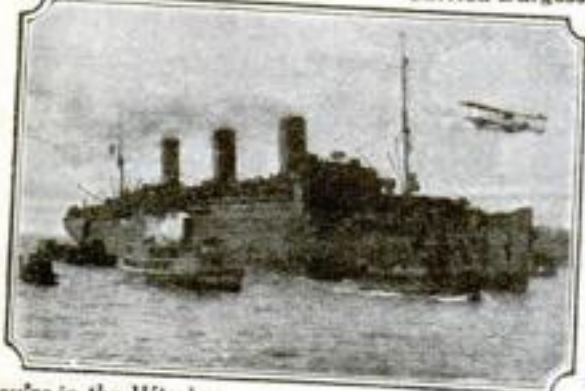
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What I Have Learned about Toys and Men

(Continued from page 163)

a harmless little dog or cat, or who have screamed when taken to the zoo.

As for every-day animals, give the child a toy cat or dog, and it will like the live ones. A child is not afraid of anything it has had as a plaything. Give it toy lions and tigers, and images of other treacherous beasts, too.

The desire to know what a toy is made of and why, teaches a child to think for himself. He takes a little steam engine apart and learns the source of power. He learns the principles of mechanics by watching the pulleys and levers work on his toy elevator.

SENSIBLE toys develop earnestness and that develops leadership. Every great leader is 95 per cent earnest. Can you imagine Pershing trifling? In playing with good toys, trying to understand their mechanism, the child concentrates, another quality needed in leadership.

Many a child in playing with toys has thought up new ideas for toys or improvements for them. Every year I receive hundreds of letters from boys and girls, and grown people too, giving suggestions for playthings. Sometimes they are practical and we embody them in new or old toys. Sometimes they are impractical from a manufacturing standpoint, but the mere fact that the suggestions are made shows that the toys are inspiring children to think. The best ideas for kites have come from boys who have thought of improvements while flying their own.

Every child likes to imitate his parents and adult friends, and toys enable him to do this. Imitation and repetition are excellent ways of impressing anything on the mind.

The first toy that most children receive is a rattle. That must have been in existence in the time of Cain and Abel. It is every baby's heritage. Before a baby is old enough to think, all it needs is something to attract its attention and amuse it.

At two years a girl should have a soft doll and a boy a stuffed horse or lion, something for which to feel affection. After this period, when the child is leaving the stage that responds only to impulse and stimuli and when its brain is beginning to develop rapidly, it is time to give it toys that will assist in this development.

BOYS up to 10 or 12 are interested in three classes of toys—friction, mechanical, and electrical. They want to build something; make something with their own hands. Girls of this age want something to make, too. They like outfits for sewing, painting, cooking, and modeling. At this age they care more for story-books than their brothers do.

For boys between the ages of 10 and 15 there are many intricate and interesting mechanical and electrical toys. Both boys and girls, in their early teens, like athletic toys—baseball bats, gloves, and masks, sleds, bicycles, tennis racquets, croquet sets, movie outfits, and fishing outfits are greeted with delight.

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Here Are Correct Answers to Questions on Page 75

1. For the same reason that a spinning baseball curves. The way the boomerang is twirled causes a special set of air-friction forces to be developed and to act on it. These drive it back toward the thrower.
2. The pituitary gland, a little organ no larger than a pea. It is located on the floor of the skull just below the brain. When it is too active, it produces the seven- or eight-foot giants. When it is not active enough, people are dwarfed.
3. Steel is iron that contains a very small amount of carbon and other elements. The carbon makes the iron molecules arrange themselves somewhat differently inside the iron. They stick tighter to each other and that makes the steel harder than pure iron is.
4. Because the skin itself grows as fast as the fat. Notice the folds of loose skin on a once fat person grown thin.
5. If you watch them for two or three nights you will see that the planets move a little; the fixed stars do not.
6. The axis of the earth, which is the line from pole to pole around which the earth rotates, is tilted a little. As the earth moves around the sun in its yearly orbit, the northern half of the earth is tilted toward the sun for half the year and away from the sun for the other half. When it is tilted toward the sun we have summer. When it is tilted the other way, we have winter. The other half of the earth, the southern hemisphere, has its seasons reversed because it is inclined toward the sun when our half is inclined away.
7. In a crystal the atoms are arranged in a certain regular way, like bricks in a well built wall. A crystal of common salt, for instance, is built up of, first, a sodium atom, then a chlorine atom; then another sodium atom and another chlorine atom, and so on.
8. Radium produces heat and we find that there is a little radium in practically all rocks. How much radium there may be in the rocks deep down in the earth's crust nobody knows. It may be that there is enough of it to keep the rocks hot or even to make them grow hotter.
9. Though this is a common question, it is a foolish one. You could not have both an irresistible force and an immovable body.
10. There are two essential differences. First, animals are able to move from place to place, while plants are not. Second, plants are able to make their own food out of sunlight and common chemicals, while animals must depend upon eating other animals or plants.
11. Fluorine. It is a poisonous, intensely corrosive gas. In its pure form it destroys all living matter, yet a very little of it, in chemical combination, is necessary for the enamel on our teeth.
12. Yes. If you pump water into one end of a full pipe, water will flow at once out of the other end. Just so with the electrons. The wire is full of electrons in the beginning. They are not moving; each one stays close to its particular atom. Then you pump more electrons into one end of the wire with a dynamo. Electrons immediately flow out of the other end.

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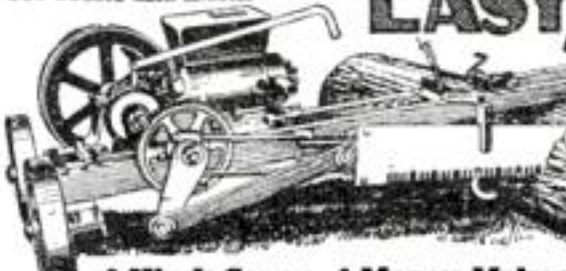
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How Typewriting Betrays

(Continued from page 46)

feet,' that is, the letters do not strike perfectly, so that part of each letter will be dark, the rest light. Or the type may be damaged either by design or through rough usage.

"In a will contest not long ago the principals in the case had reason to believe that the meaning of the document had been changed by the addition of a clause to a certain paragraph. The typing of this disputed section was lighter than that of the rest of the will, and the defending lawyer explained this by saying that this part had been typed a day later than the rest, the same typist using a much lighter touch.

"AN EXAMINATION of the will showed it had been typed on a machine the letters of which shadowed themselves slightly, presenting the appearance of double letters. Repeated tests showed that the machine would not shadow under a light touch, but invariably shadowed under a heavier touch, no matter what the condition of the ribbon.

"These tests were sufficient to prove that the same pressure had been used in typing the second half of the paragraph, and that the work had been done long after the first part had been typed, when the ribbon was weaker from continued use.

"Not long ago two government agents called at my office and placed a mimeographed sheet on my desk.

"What can you tell us about this?" they asked.

"The only thing I could tell them at the time was that the stencil had been cut on a typewriter of a certain make. Further examination disclosed what brand of stencil paper had been used. I also learned the name of the manufacturer of the mimeograph paper. Now, in thousands of business offices in New York City mimeographing is done every day. There are several hundred concerns also that do commercial mimeographing. To find where this particular sheet had its origin would seem like an almost impossible task.

"HOWEVER, the fact that a certain make of typewriter, a certain brand of stencil paper and a certain kind of mimeograph paper were used in preparing the sheet narrowed the search somewhat, and eventually the office where the mimeographing was done was found. The details of the case on which the federal agents were working I never knew, but through the data revealed by the typing, the identity of the person who reproduced the copy was established.

"Substitution of letters in repairing a typewriter often has been a means of identifying a machine as having done a certain piece of typing. Manufacturers sometimes change the form of one or two letters when they put out new models. The r on a well-known typewriter was changed recently, and the manufacturer informed me of the change. That knowledge may help me solve a case some day.

"Knowledge of the change of a cent mark (¢) on a certain type of machine

(Continued on page 167)

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with the*

UNCLE SAM MASTER TUNING COIL

MR. L. E. BROWNE, writing in the New York Sun Radio Section of August 30th about the reception of Broadcasting from Lieut. Brandt's De Havilland plane speeding at 75 miles per hour, 3000 feet above New York, states:

—"and N. T. G., who was at Palisades Park trying to pick him up with an EIGHT TUBE SUPER-HETERO-DYNE seemed to be having trouble. Although we had only half of this—four tubes... hooked up with an UNCLE SAM COIL—we brought the whole thing in on the loud speaker as clear as a bell."

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A. O. LEONARD, Suite 301, 70 5th Ave., New York

How Typewriting Betrays

(Continued from page 166)

once pointed to the spuriousness of a document. In this case I was able to identify the machine on which the disputed document was typed as one that carries its type on a circular shuttle that turns and against which the paper is impressed at each stroke. Certain mistakes in the typing could not have been made on any other typewriter.

"Some typewriter manufacturers make their own type, others have it made by type founders, and when a type founder supplies the same or almost the same kind of type for two different kinds of typewriters, complications are almost certain to result if one attempts to identify a specimen of work done by either machine.

"AN INSTANCE of this occurred in the longest case I ever handled, one that required months of work and a nationwide search for a single typewriter. The principal was a woman who was suing for a share of a large estate on the ground that she had been the common-law wife of the dead man. To prove her contention she offered a typewritten letter, which she said had been signed by the man. Typing and signature were believed to be false.

"When I examined the letter I believed it had been written on a certain typewriter. When I went to the factory to substantiate my opinion, I found that machines made by this company at the time the disputed letter was dated, were likely to have type made by the company itself or by either of two type makers. I found also that one of the type makers also made the type for a portable typewriter, and that the deceased had owned one of these.

"I knew that the woman and the man had lived in many places throughout the entire country. A thorough search was made of their former haunts for typewriting and machines, but with no results. Through it all, however, a strong 'hunch' persisted in telling me that the disputed work had really been done somewhere in New York City. With the aid of detectives I found at last a place with more than a hundred typewriters to which the woman in question at one time had access.

"I KNEW the machine I was looking for had to have 10 letters to the inch. So I had detectives get me secret samples of the work of every typewriter in this place. I quickly weeded down the samples to include only 10-point writing. Thus a country-wide search was narrowing down to a score of machines.

"On these specimens I looked particularly for some of the 18 minute characteristics I had found in the type impressions on the disputed document. I knew, for instance, that the desired machine would have certain small imperfections in the *t* and *a*. As I went through the final batch of samples, seeking first one telltale defect, then another, I finally found a sample that coincided perfectly in many particulars. This was irrefutable proof that the culprit machine had been discovered!

"I requisitioned this, and additional

(Continued on page 168)



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How Typewriting Betrays

(Continued from page 167)

samples taken from it strengthened its guilt. Not only that, but before the machine was obtained, the questioned writing had shown me that it had been made by type turned out by the makers of the typewriter instead of either of their outside type makers. The machine itself verified the fact that it was not in existence at date of the letter, thus proving the date of the alleged letter to be false as well as the letter itself."

ALTERATIONS and erasures, Mr. Horton told me, whether in type-writing or in longhand, frequently are revealed by chemical tests. Though the original writing may have been obliterated so successfully that the eye sees no trace of the change, it frequently happens that traces of the ink or typewriter ribbon will remain on the paper. In such a case, treatment with certain chemicals will cause the erased writing to appear once again, faintly perhaps, yet clearly enough to be discerned and recorded by the microscopic camera. This method is of especial value in detecting raised checks or those on which the name of the payee has been altered.

Knowledge of the purely mechanical characteristics of various makes of typewriters likewise is an essential part of the equipment of a questioned-document expert.

Any expert typist will tell you that it is impossible to insert a sheet in the identical position it held before in case it is necessary to make an alteration in a piece of typing. And so when an alteration of this nature is made with criminal intent, even though the same typewriter be used with a ribbon in the same condition, the substitution usually will be apparent to the expert through exceedingly minute differences in spacing and alinement between the original document and the altered part.

Detection of small differences in spacing, Mr. Horton told me, once enabled him to save the heirs of a wealthy man a large sum of money, an innocent paper which the deceased had signed having been changed into a "note" by a clever rascal.

Thus science as exemplified by the questioned-document expert protects society against the depredations of the criminal, safeguarding the good name and property of both the living and the dead by hampering the thief, the forger, the blackmailer, the writer of anonymous letters—all who by pen or typewriter seek to prey on their fellow men.

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They Did the Impossible

(Continued from page 50)

duction scheme, though it showed we were on the right track. Finally, we tried blowing the hole through with a current of heated air, and the problem was solved theoretically.

"There remained, however, the question of practical and economical production. Our engineer accomplished this by constructing special machines that automatically do the work we did by hand.

"These machines are a marvel of precision, performing delicate work more accurately and quickly than it can be done by hand."

IT WAS then my privilege to witness one of the marvels of modern engineering—steel fingers shaping brittle glass into perfectly sealed vacuum bulbs.

One machine made the standards, the little glass tubes that hold up the glass filament posts. An automatic feeder fed the standards into a horizontal circular machine about four feet in diameter. Sticking out all around the circle were many little pairs of tongs. Each pair, with almost human precision, grasped a tube standard from the feeder.

The circle rotated in steps. First the standard received a sealing tube, which was automatically welded in as the circle slowly rotated, bringing the standard into successive contact with little gas flames. Then air was blown into the sealing tube, bursting a tiny hole through the almost molten glass.

Next, the standards, ready for the filament, were carried in boxes to another machine. Here a girl wound on the filament, connected and set the standard in a machine, filament upright. The sealing tube connected with a pipe, which at the proper time was connected with an exhaust pump. Then the glass bulb was placed over the standard, and the machine did the rest—welded the bulb to the standard, exhausted the air, and sealed off the little sealing tube. Finally the brass base caps were cemented on.

It was not a method of eliminating the tip—the lamp never had one!

And what are the advantages of the tipless lamps? In the first place, they are cheaper to you and me. Less breakage and the fact that the job is practically automatic, requiring much less skilled labor, is the reason. It is surprising how hard it is to break the new lamps. In the little experimental factory, they are carted around in iron bins just like bolts.

ANOTHER advantage is the fact that the lamps can't be refilled without detection. Finally, it is possible to place the filament exactly where it is wanted inside the bulb, a great advantage in the case of miniature lamps for autos where the slightest variation in placing the filament will throw them out of focus.

So it was that a problem that puzzled the scientists was solved by practical men who kept hunting until they found the way.

By the time this is printed, tipless vacuum tubes for radio will be on the market, and the price of them will be down, according to the two young inventors.



New
Tan Oxford
for Women

Attractive pattern in light
Russia calf with Storm Welt.



W.L. Douglas

\$5, \$6, \$7 & \$8 SHOES

BOYS AT \$4.50 & \$5.00

Women of fashion should know that our women's shoes are high-class, made in the most distinctive, up-to-date and exclusive styles, which appeal to those who desire stylish, comfortable and serviceable shoes at reasonable prices.

W. L. DOUGLAS PEGGING
SHOES AT 7 YEARS OF AGE

WEAR W. L. DOUGLAS SHOES AND SAVE MONEY

FOR 38 YEARS, W. L. Douglas' name and portrait have stood for quality, for economy and for satisfactory service. W. L. Douglas shoes are exceptionally good values. Only by wearing them can you appreciate their superior qualities. *The exclusive, smart models, designed especially for young men and women, are leaders everywhere.*

W. L. DOUGLAS \$7.00 SHOES are remarkably good value. Seldom have you had the opportunity to buy such *high-grade* shoes at this popular price. Shoes of equal *quality, comfort and service* are rarely found in other makes at our prices.

WHEREVER YOU LIVE demand W. L. Douglas shoes. They are sold in 120 of our stores in the principal cities and by over 5,000 shoe dealers. For *economy and dependable value*, wear shoes that have W. L. Douglas' name and the retail price stamped on the soles. The *stamped price guarantees the value*. If not for sale in your vicinity, write for catalog.

W. L. Douglas Shoe Company, 124 Spark St., Brockton, Mass.



New
French Toe
for Men

Smart style in light
Russia calf at a popular price, \$6.00



**The Ideal Rheostat
for All Tubes**

The Marshall-stat provides a means of obtaining any desired tube adjustment with absolute precision. The Marshall-stat varies the resistance, not step by step, but smoothly, continuously, and uninterruptedly from zero to maximum.

The Marshall-stat provides vernier precision throughout its entire range. Yet there is only one knob to manipulate—no double adjustment to make.

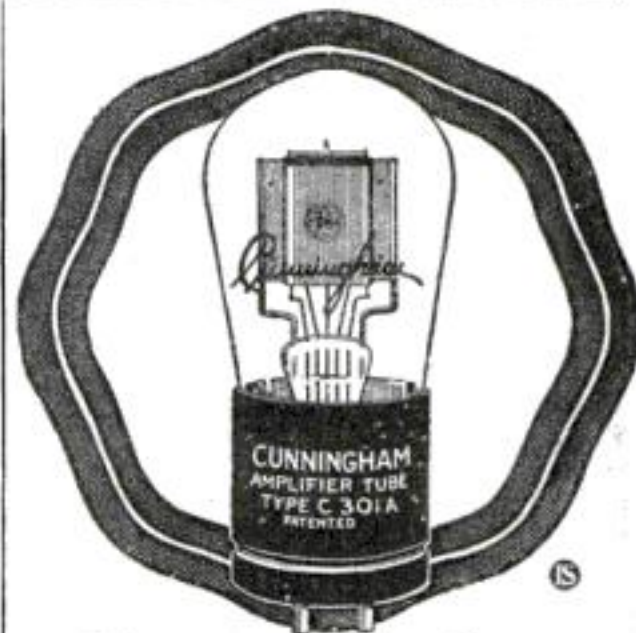
Besides its precision and ease of operation, the Marshall-stat requires only one hole in the panel, has only two terminals, can be used with any tube or combination of tubes, and is so scientifically constructed that breakage of the specially-treated Marshall discs is impossible. Compact—note full-size cut above. Can be fitted anywhere.

Price \$1.75.

MARSHALL ELECTRIC
COMPANY

3241 Locust Blvd., St. Louis, Mo.

Send for Old Man Ohm's descriptive folder on the Marshall-stat.



**Cunningham
RADIO TUBES**

*Quality Plus Service
Since 1915*

THE General Electric Laboratories produce these tubes which "Since 1915"—a Radio Lifetime—have consistently made good their claim of exceptional accuracy.

Price the same on all five types—
C-301A, C-299, C-300, C-11, C-12

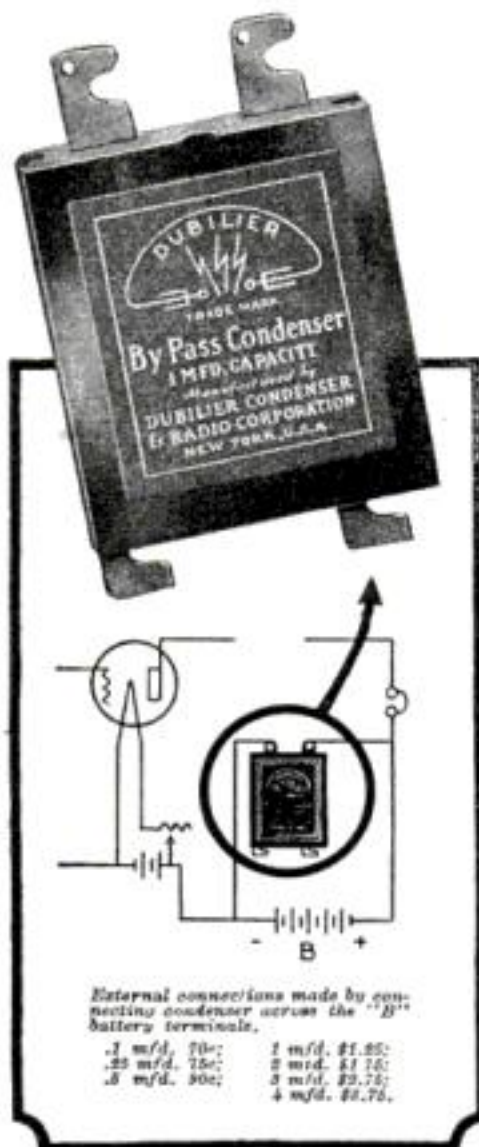
Patent Notice: Cunningham tubes are covered by patents dated 2-18-08, 2-18-12, 12-30-13, 10-23-17, 10-23-17, and others issued and pending. Licensed only for amateur experimental and entertainment use in radio communication. Any other use will be an infringement.

Cunningham 40-page data book fully explaining care and operation of Radio Tubes now available by sending 10c in stamps to San Francisco Office.

E. J. Cunningham Inc.

HOME OFFICE
SAN FRANCISCO CHICAGO NEW YORK

The By-Pass Condenser



YOU will get the program clearer if you install a Dubilier large capacity By-Pass Condenser in your radio set. Just locate it as the diagram indicates. The result is that the minute fluctuations of the "B" battery are smoothed out into a steady, even flow of current, devoid of all noises.

The result is astonishing! Signal strength is increased—tones purer—volume smoother. The whole program comes in far truer and pleasanter than ever before.

This By-Pass Condenser in quality of material and workmanship measures up to that high standard for which all Dubilier radio devices are famous.

Dubilier

CONDENSER AND RADIO CORPORATION

BE YOUR OWN FIXER WITH SMOOTH-ON No. 1

—and save your repair money for bigger things.

Cracked heating boilers, radiators, water pipes, tanks, leaky ovens, furnaces, stove pipes, loose handles, leaky automobile radiators, hose connections, gas tanks, cracked water jackets and gear cases, loose nuts, grease cups and hub caps are usually a snap to repair with Smooth-On No. 1—and with a saving of anywhere from 25c to \$25.00 each time.

144 pages
This Book
FREE

Get a 6-oz., 1, 5 or 10-lb. can of Smooth-On (from any live supply store).

The repair booklet which we send free if you mention this magazine, will help you to get good results.

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REPAIR
BOOK

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12 Cells
24 Volts
Solid
Rubber
Case

\$3.50⁵⁰ COD SPECIAL
INTRODUCTORY PRICE

For a limited time only, and to introduce this new and superior Storage "B" Radio Battery to the Public, we are selling it for \$3.50. Regular Retail Price is \$5.50. You save \$2.00 by ordering NOW. A finer battery cannot be built than the

World Storage "B" Battery

(12 CELLS—24 VOLTS)

To ten million homes with Radio Sets—and to countless millions of prospective buyers—this WHOLE Storage "B" Battery brings a new conception of battery economy and performance. Here is a battery that pays for itself in a few weeks—will last for years and can be recharged at a negligible cost. And you save \$2.00 by ordering now.

A Superior Battery Equipped With Solid Rubber Case
Has heavy duty 2 1/8 in. x 1 in. x 1-4 in. plates and plenty of acid circulation. Extra heavy glass jars allow ready observation of charge and prevent leakage and seepage of current. It holds its charge, while idle, at constant voltage. You will find this battery a boon to long distance reception. It does away with a great many noises so often blamed on "static." Mail your order today.

SEND NO MONEY

Just state number of batteries wanted and we will ship ~~per~~ order is received. EXTRA OFFER: 4 batteries in series (96 volts), \$12.00. Pay Expressman after examining batteries. 5 per cent discount for cash in full with order. Send your order NOW and save \$2.00.

WORLD BATTERY COMPANY
Makers of the famous World Radio "A" Storage Battery
1219 S. Wabash Ave., Dept. 80, Chicago, Ill.

SAVE \$2.00 BY ORDERING NOW!

How to Wash Your Hands

(Continued from page 52)

little mutton tallow into the skin when dressing, then cover with tissue paper and draw up the socks or stockings over the paper.

Many people who otherwise would be in constant misery can go through the winter very comfortably in this way.

A MAN of 52 years, in business, came to me one January complaining of itching of his legs from the middle of his thighs down to his feet, and occasionally of the arms and forearms. He told me that the itching always was worse when the skin was exposed to cold, or when he undressed, or when the skin was rubbed. Moderate restriction of his bathing and the use of a thin salve containing lanoline gave him complete relief.

Frostbite is a real freezing of the skin, and fortunately is not common except, perhaps, in the most northern parts of the country. The bodily extremities are most apt to suffer—the ears, toes, and fingers, and then the nose and cheeks. The first sign of trouble is often the loss of feeling. The ears do not feel as cold as they did, not because they feel warm, but because they have no sensation at all. The skin becomes white instead of red, and feels harder to the touch. If the trouble is discovered soon, it can be cured without ill effects, although a part once frostbitten is usually sensitive to cold for years afterward.

If the freezing is allowed to continue, recovery may be impossible, and the affected skin, when it thaws, will become gangrenous and drop off. The treatment in such a case is of the greatest importance. The thing to remember is that the thawing out must be gradual. A rapid thawing, such as by wrapping the part in hot cloths or placing it in hot water, often will result in gangrene.

THE old method of rubbing the frozen member first with snow is as good as it ever was. Gradually, as the flesh thaws out, the color will return and the circulation will be re-established. If snow is not available, rub with cold water, and do it all in the open air, not in a warm room.

No directions for the care of the skin, in winter or summer, would be complete without reference to your general health, for the skin is often a good index of a man's condition. Follow a varied diet, being particularly careful to include green vegetables and milk, which provide vitamins as well as nourishment; but avoid any excess, especially of sweets and meat. Ordinarily, in the United States, more harm is done by overeating than by undereating.

Take eight hours' sleep every night, always rest half an hour before the hearty meal of the day. Last, and the most difficult to follow, take at least an hour's exercise in the open air every day. In other words, put yourself, and keep yourself, in the best possible physical condition, and you will be relieved of many of the annoyances that in their sum total make the difference between comfort and misery, between spontaneous cheerfulness and continual ill humor.

How I Play Radio Doctor

(Continued from page 79)

voltage is lower than these values, you must get new B batteries. Discard only those that are low, in case you have two or three B batteries.

To test the telephone plug, touch the point of the plug to one terminal of a 22-volt battery and connect the wire from the barrel of the plug with the other battery connection. This should give a strong click. If it does not, take off the plug and touch the telephone cord tips to the battery terminals. If you hear no sound or only a very weak sound, the telephone cord is broken inside the insulation or the magnets have lost their magnetism. Take the telephones back to the dealer, but do not open them to examine the inside. You may accidentally break one of the tiny wires.

Some types of loudspeakers and telephone receivers must be connected in a certain way. If the tips are reversed when they are connected with the plug, the signals will be weaker and, in a short time, the permanent magnets may lose their magnetism. You can experiment by connecting the tips one way and then the other to see if there is any difference in the signal strength. Leave them in the position that gives the loudest signals.

When you buy a radio set, ask the dealer whether the positive lead from the phones should be connected with the point or the barrel of the plug. Most phones have a terminal on the receiver cap marked +. If this is the case with the new set, be sure that lead goes to the part of the plug that the dealer says should take the positive tip.

You may find that all these tests do not bring out the source of trouble. If they do not, the trouble may be in the tubes, for at times the tubes will light even though they are defective. It is always well to buy tubes from a dealer who has one of the standard tube-testing instruments. Then you can be sure that your tubes will be right when you buy them. Dealers handling standard makes always will replace defective tubes if the filaments have not been burned out.

THERE are two other things that must be considered. The first is the storage-battery charger. Once you have become acquainted with this device you should have no further trouble with it, but it may puzzle you the first time. Be sure to connect the positive lead from the charger to the positive terminal on the storage battery. Some people think that, since positive usually goes to negative, the + terminal of the charger should go to the - connection on the battery. As a matter of fact, in this case positive goes to positive.

Successful battery substitutes now are being put on the market and every one is thinking about using them instead of batteries. Unless you get a device that will replace A, B, and C batteries, you will not save money, although, to be sure, it is much easier to hook on to the light socket and do away with the necessity of bringing home B batteries. When you buy a substitute device, get it from a dealer who can install it for you. Once it is put in, you will have no trouble using it.

To everyone on the list—give Eveready flashlights!



EVEREADY
FLASHLIGHTS
& BATTERIES
—they last longer



No. 2671—Eveready 2-cell Focusing Spotlight with the 200-foot range.

Eveready Unit Cells fit and improve all makes of flashlights. They insure brighter light and longer battery life.



AGAIN the Christmas season! Suggestions and counter-suggestions . . . "Give this" . . . "Give that." Here's the happy solution: Give flashlights. Everybody wants an Eveready.

Because it is a gift that is good-looking as well as practical and safe; because it appeals alike to young and old; because it does so much and costs so little.

Everybody wants an Eveready. There are the Eveready Focusing Flashlights, with 200, 300 or 500 foot range. Great for motorists and motor-boatists. Broad-beam lights for Mother and Dad to use around the house. Handsome nickel or

ribbon black cases. Just take your gift list to the nearest Eveready dealer. Save wandering and wondering.

The improved Eveready line comprises twenty-two fine flashlights in four general types. New designs. New features. But old prices—65c to \$4.50, complete with battery—anywhere in the U. S. A.

Buy them from any electrical, hardware or marine supply dealer, drug, sporting goods or general store, garage or auto accessory shop.

Manufactured and guaranteed by
NATIONAL CARBON COMPANY, Inc.
New York San Francisco
Canadian National Carbon Co., Limited
Toronto, Ontario

Folks/meet a friendly condenser

Dear Fred:

I didn't know what a real pal my Radio was until I equipped it with the Rathbun Superior Condenser. The single-hole-mounting feature certainly saves a lot of time and trouble. Thanks for the tip.

I'm driving to the city Sunday and hope I'll find you home.
Your friend,
Bill



®

You fellows who don't claim to know all about condensers, may learn something worth while about a friendly condenser. You, too, may not know what a real pal your Radio set is until you equip it with a Rathbun single-hole-mounting Superior Condenser.

Compare 'em at your dealers or write (mention Popular Science Monthly) for complete details. Prices: "3 to 43 Plates"—\$1.00 to \$6.00. Rathbun Manufacturing Company, Inc., Jamestown, N. Y.



RATHBUN SINGLE-HOLE MOUNTING SUPERIOR CONDENSERS

Molded on every original single-hole-mounting low-loss unconditionally guaranteed Condenser.



Don't Blame Your Set!

If the batteries run down, you're lucky to get anything but "sounds."

APCO Battery Charger keeps radio batteries alive. Works noiselessly, efficiently, surely, fully charging any radio battery over-night for a few cents. 7½ ampere capacity. Pays for itself in six months. Guaranteed one year.

Write for circular and dealer's name

APCO MFG. CO.
Baker Street, Providence, R. I.

APCO BATTERY CHARGERS
for "A" and "B" Batteries

SAVE 25% SEND NO MONEY

Genuine Diamonds
(Cut Stones—Not Chips)
Snappy, White and Brilliant
Terms: Monthly Payments
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Wedding Ring No. 6177—
3-Stone Diamond, 4/100
Each, 20-kt. White Gold ... **\$25.00**

Ladies' Ring No. 6405
—in 18-kt. White Gold
Exact size of ring..... **\$30.00**

Our white gold looks and wears like platinum.

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—18-kt. White Gold Top and Green Gold Shank. Exact size of Ring..... **\$35.00**

Emblem or Initial Ring No. 6132
Solid Gold with 2 Genuine Diamonds 4/100 Each..... **\$25.00**

14-kt. White Gold Top, Gold Emblem or Initial inlaid in Genuine HOPE RUBY, or BLACK ONYX. Furnished in all lodge emblems and in all initials (Old English).

Send size of finger and ring desired will be sent for inspection. Terms—monthly payments if desired.

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No. 6177



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No. 6132

This Reg. Trade Mark guarantees you genuine diamonds
D F G M S W Any Letters

Confessions of a Radio Gyp

(Continued from page 78)

we got full price for tubes, but when the national manufacturers' caught up with the market, we had to cut prices on the bootleg variety to meet the competition. Now all makes of tubes are gypped at cut prices.

THE jobbers help the gyps to do that. A jobber often will sell a large order of tubes at a small margin of profit for cash. There usually isn't much profit for the gyp in selling genuine tubes at cut prices on this basis, but the cut rates on tubes generally will entice the customer into the store, after which the gyp will use his wiles to unload a quantity of other goods on him. Often you will find, if you try to buy the tubes that are advertised at cut rates, that there's a string on the offer. Before you can buy a tube, you must buy other merchandise—usually stuff that you don't want and that is no good.

Formerly we used tubes to help us sell sets. All the sets on display in our show-cases contained good tubes, so, of course, if the customer wanted a demonstration, the set worked. But if the customer bought the set, while it was being wrapped up, one of our helpers would slip in a set of bootleg tubes. If the purchaser came back, we told him that the location of his home must be bad for radio reception, and pointed out to him how well the set had worked in the store.

Most of the time he'd believe us, because it had become pretty well known that certain places were "dead spots" for radio. When he was convinced that the fault lay in the location of his home, it was comparatively easy to sell him a lot of additional parts that he didn't need and that wouldn't help his set any.

SPEAKING of radio sets, they're the big sellers now. The public isn't buying so many parts as it used to. But many a patented set has been sold over a gyp counter that never saw the factory of the company whose name and serial number it carried. Many ex-tube bootleggers now are bootlegging the more popular sets.

You may have wondered how we can offer some sets at the prices we do. Sometimes this has been done just to get even with a manufacturer who wouldn't sell us his products. We'd go out and buy the sets that the manufacturer wouldn't sell us at the retail stores, and advertise them at unbelievably low rates. We'd fit them with poor tubes, hook up the batteries wrong, and then, when the customer came in for a demonstration, we'd show him the set and tell him it was no good. That way of getting even with a manufacturer was very popular for awhile—until one gyp was arrested and convicted for unfair practices.

One thing that has hurt the gyp stores is the number of broadcasting stations installed in the big cities. Receivers made by gyp manufacturers are never very strong on selectivity, and, if two or three local stations happened to be on the air at once while the customer was getting a

(Continued on page 173)

Confessions of a Radio Gyp

(Continued from page 172)

demonstration, it would be impossible to sell him the set. Then along came somebody with the wave-trap idea. It didn't take us long to see that wave-traps were what we needed to sell our bad receivers. So, when giving a demonstration, we'd hook a wave-trap up in the aerial where the customer couldn't see it, and let a clerk operate it while another clerk was demonstrating the set.

Then, of course, if the customer came back to complain that his set wouldn't work as well at his home as it did in the store, we'd blame it on his location—and sell him a wave trap. Some of these wave traps worked, others didn't; for we'd made them out of cardboard couplers and gyp condensers. A good wave-trap was an efficient device, but the imitations that the gyps put out destroyed public confidence in it, and now you seldom see one.

LOUDSPEAKERS, too, have been very profitable to the gyps. It's easy to take the reproducing unit from a good horn and substitute a cheap one. Then the price of the horn can be cut with profit. After that the good unit can be used as a phonograph attachment and sold at a good price.

Even batteries have been gypped successfully. The gyp manufacturer finds it easy to make B batteries cheap—sawdust and some sort of chemical mixture in cheap cans. They run for a couple of weeks and then die. That's always been good business for the gyps, because of the repeater trade from customers who don't know any better.

I remember a cheap grid leak that a gyp manufacturer put out. One day a fellow from a testing laboratory came into our place and bought one. He didn't tell me what he wanted it for until he was on his way out, or I'd never have sold it to him.

A long time afterward I happened to meet this man on the street.

"How about that grid leak you were going to test?" I asked.

He didn't remember me at first, but when I told him who I was, he laughed.

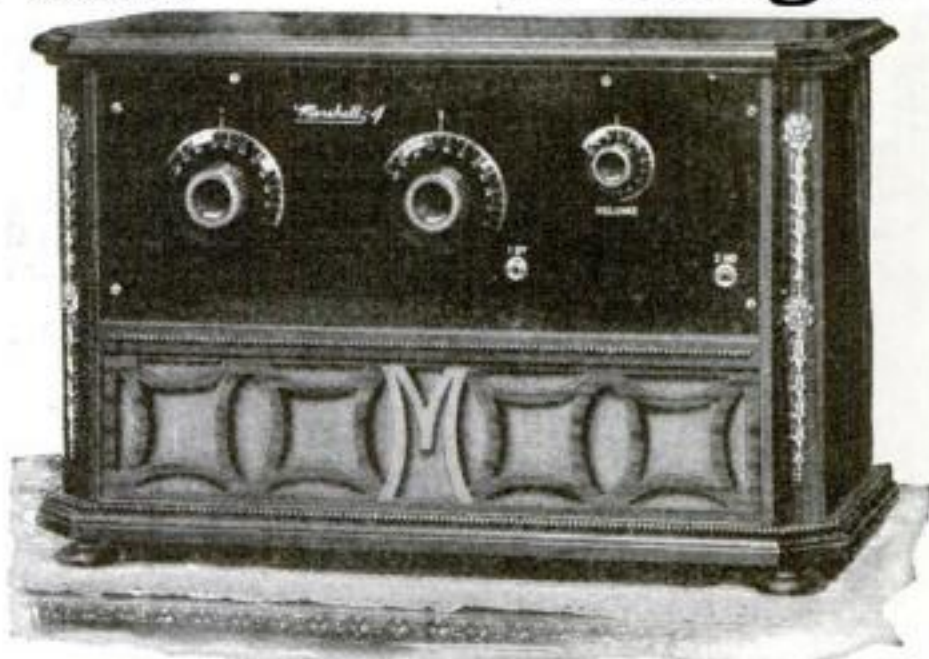
"Why, that leak wasn't any good at all," he said; "but its mount was of such poor material that it made a good leak in itself."

THINK of that, will you! I never could understand why we sold so many of those leaks.

But as I said before, the gypping business isn't what it used to be. The people won't bother chasing cut prices while they can buy the best sets, manufacturer's guarantee, and everything, on time. This doesn't mean that the game has played out altogether. There's still plenty of gypping going on, and the man who doesn't know much about radio had better watch his step when he buys. The public's best protection lies in buying only articles made by manufacturers whose names and trade marks are well known, and then only when the article is in a sealed container with the seal unbroken.

An Amazing Advance in **RADIO** Design

Marshall
3-4
and 5
Tube Sets



**This Beautiful
Marshall 4 Tube
Non-Oscillating Receiver** *only \$5⁰⁰
DOWN*
Complete with all accessories

WRITE TODAY for full particulars of this most exceptional offer. Marshall Sets embody the very latest improvements known to radio. The wonderful new principle involved is proving the sensation of the 1924-25 radio season. Zero Coupling—the problem which radio engineers have been working on for years—has at last been solved. As a result, the Marshall has no need for neutralizing condensers or other make-shift methods of avoiding internal oscillations which invariably reduce efficiency. The Marshall Tuned Radio Frequency Receiver brings to radio a new degree of musical quality. Its selectivity will delight the experienced radio operator. Yet it is so easy to tune that the novice will handle it like an expert.

Easy Monthly Payments—2 Weeks Free Trial

That is the remarkable offer we are prepared to make to you! Two weeks to prove that the outfit you select is everything we have said for it. If it doesn't make good our claims, back it comes, and your deposit will be cheerfully refunded. But if it fulfills all your expectations, you may pay for it in easy monthly installments. You don't risk a cent when ordering from us. You *must* be satisfied, or we don't do the business.

Is it any wonder that the radio buyers the country over are rushing to take advantage of such an offer? If YOU are interested, figure on getting your order in early, while prompt shipment can be made. Everyone predicts a serious shortage of radio supplies this season. Send for full particulars today.

Beautiful Solid Mahogany Combination

Compare the beautiful Combination Cabinet, pictured above, with the usual radio box and horn. Here the Receiver and Loud Speaker are contained in a single handsome cabinet. Or, if you prefer, we also have the Receiver in a separate cabinet of the same design. These cabinets are the work of a master designer—fashioned of solid mahogany. They will harmonize with the furnishings of the finest homes. In spite of the extra value, these Marshall sets are surprisingly low in price. Compare them with others which sell for cash. Then remember you can order a Marshall outfit on two weeks' free trial and pay for it on very easy terms.

Complete Outfits if Desired

In buying from Marshall, you have the choice of a set complete with all accessories, or the set alone. You have choice of dry cell or storage battery outfits. Unless you already own the accessories, you can buy them from us at less-than-market prices, with your set on easy terms. Your outfit will come all ready to set up and operate within a few minutes,—saving time and trouble—and saving money, too.

Send Coupon for Special Offer

If you have any idea of buying a radio set this year, don't let this chance slip by. Our terms and liberal guarantees have set a new pace in the radio business. The low prices we will make you on a 3, 4 or 5 tube Marshall set will surprise you. A letter, postcard, or just the coupon will do. But send it today!

We also have a most favorable offer for radio dealers. Write.

Marshall Radio Products, Inc.
Marshall Blvd. and 19th Street
Dept. 13-69 Chicago

Marshall Radio Products, Inc.
Marshall Blvd. & 19th St., Dept. 13-69 Chicago
Please send me your special offer price, terms and full description of Marshall Radio Outfits. Though I may change my mind on receiving your proposition, my preference now is for a:

.....3 Tube4 Tube5 Tube (Please check)

Name.....

Address.....
(Print name and address plainly)

A-B-C's of Radio Language

(Continued from page 80)

this transfer of electrical energy is something like the transfer of heat from a piece of red-hot iron to another piece of metal that is near it. Also, there is a re-transfer of the induced energy from the second coil back to the first, and from the first coil in turn back to the second, quite as two electric fans facing each other might blow bits of a handful of confetti back and forth between them. This bandying of electrical energy back and forth is called *mutual inductance*. A coil also has the odd property of inducing a magnetic field on itself by *self induction*.

Years ago an electrical experimenter discovered that the mutual inductance between two coils varies in accordance with the distance between them and the angles at which they are placed with reference to each other. This principle was utilized in designing the device we are examining. The amount of mutual inductance between two coils is called the *coupling*. Hence, *variocoupler* is a vivid and understandable name for a device that permits mutual inductance to be varied at will by rotating one coil about its axis within the other.

A somewhat similar device found in some sets is called a *variometer*. This also is used to vary inductance and consists of two coils, one of which turns inside the other, but, instead of being separate, as in the variocoupler, the two coils are connected in series.

LIKEWISE variable inductances are produced in crystal sets by mounting two parallel coils one inside the other so that the outer coil may be moved back and forth over the inner, or by providing a single coil with one or two slides that have the effect of increasing or reducing the number of turns of wire that compose the coil by making contacts at various points.

Indeed, a method very similar to this last is employed in the set we are inspecting. The primary coil of the variocoupler has been *tapped* at various points, each an equal number of turns from the next. Wires from these *taps* are connected with the *points* to which you may move the switch you see on the front of the panel by turning the knob marked "Primary Inductance." Each time you move the switch from one point to another, the effect is to increase or decrease the size of your primary coil.

Thus, in addition to varying the mutual inductance between the two coils that make up the variocoupler, you also are able to vary the inductance of the primary coil, giving you a greatly increased variation in tuning.

Now, to complete the operation of tuning, there is another factor in addition to varying the inductance of your set to accommodate it to the frequency or wave length of the radio waves you desire to admit. You must vary another electrical property, known as *capacity*. This you accomplish in the particular set we are considering by turning the dial lettered "Antenna Condenser."

The *antenna*, of course, is the aerial. Each aerial has what is called a *natural*

period of vibration, or *natural frequency*, just as each string of a musical instrument has its natural tone unless otherwise tuned. This makes the aerial sensitive to radio waves of a certain frequency, just as the string of a musical instrument will vibrate in sympathy when the note to which it is tuned is sounded on another instrument near by. And, as with a musical string, you make your aerial sensitive to other frequencies by changing its length—not actually, but by adding or taking away capacity by means of the condenser.

A condenser is a device that will store up electrical charges. It is not to be confused with a storage battery, for the latter stores up quite a different kind of electricity and in a different way. Two or more conductors of electricity, separated from one another by a non-conductor, form a condenser. Thus, two sheets of tinfoil placed on opposite sides of a sheet of glass will be a condenser and will store up electricity that is admitted to the tinfoil until the accumulated charge becomes too great. Then the charge discharges by leaping from one sheet of tin-foil to the other. The conductors in a condenser are known as the *plates*, the non-conductor, the *dielectric*.

IN THE condenser in our set the air is the dielectric. The plates are the parallel metal sheets, one set of which slips between the plates of the other set when you turn the condenser dial, somewhat as you might entwine your fingers. The two sets of plates, however, unlike your fingers, do not touch; they must always remain separated by the air dielectric if the device is to function as a condenser.

This sort of device is called a *variable condenser* for the obvious reason that it permits you to vary its capacity by turning the knob, the capacity being greatest when the plates are closed and becoming less as the two sets are separated. In some condensers of this type there is a single additional plate, operated by a separate knob, which may be adjusted after the setting of the condenser has been made. The trifling variation in capacity possible through the use of this device permits of finer tuning. Such a device is called a *vernier*.

As explained in previous articles, the radio waves that reach your antenna are alternating current waves of high frequency. Any electric circuit offers opposition to alternating current, this opposition being called *impedance*.

In the set we are considering, or in any other set for that matter, you admit waves of a particular frequency by adjusting your inductance and capacity so that the impedance is low with regard to that frequency and high with regard to all other frequencies. That is the purpose of the three knobs at the left-hand side of the panel and the devices within the set with which they are connected.

In sets of very recent design the trend has been toward supplying them with fixed inductances—that is, unadjustable coils—and tuning entirely by varying the capacity by means of condensers.



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THE unqualified endorsement of these leading radio manufacturers is in itself the greatest recommendation of Spaulding Bakelite-Duresto quality.

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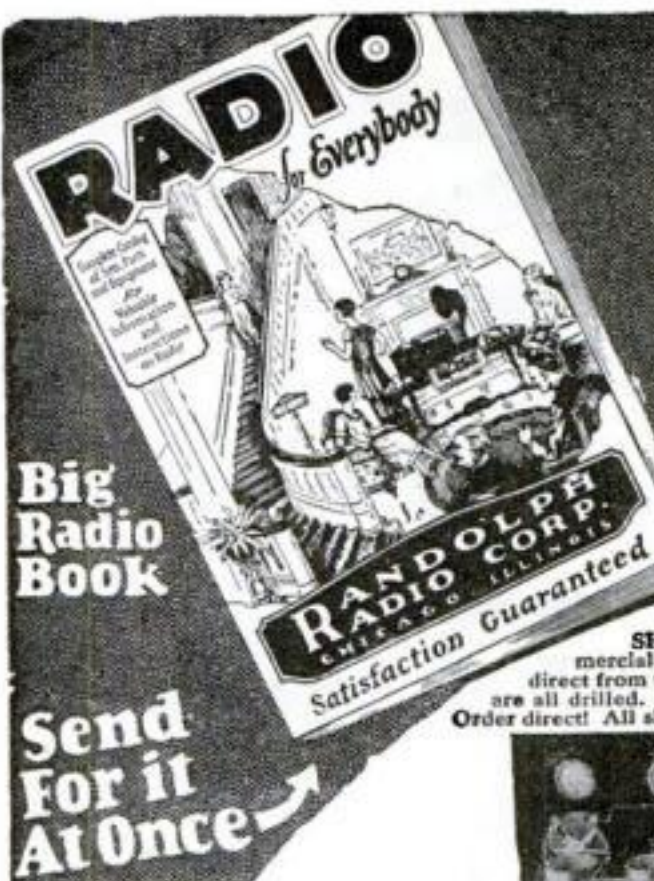
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COMPLETE PARTS FOR 5-TUBE NEUTRODYNE RECEIVING SET

Genuine Hazeltine Licensed Neutrodyne Parts Furnished.

- PARTS FOR 5-TUBE SET:**
- 1 7 x 24 x 3/16 Drilled Panel
 - 1 Thordarson or Columbia Audio Transformer
 - 4" Bakelite Dials
 - 7 Precision Jacks
 - 1 Bakelite Rheostat—30-ohm
 - 1 Bakelite Rheostat—6-ohm
 - 1 Bakelite Binding Post Strip
 - 1 .001 Condenser
 - 1 .006 Mica Condenser
 - 35 feet Hook-up Wire
 - 1 Kit consisting of 3 Hazeltine Licensed Neutrodyne parts and 2 Neutrodons
 - 1 Baseboard
 - 2 Bezels
- \$33.75**
- Complete blue-prints and working diagrams and instructions.

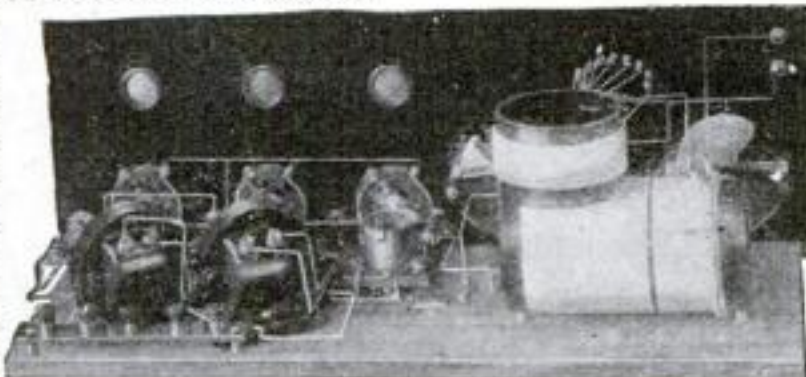
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Complete Parts for Two-Stage Amplifier

May Be Used in Connection With Any Receiving Set

- 3 7 x 9 Bakelite Panel
 - 1 Thordarson or Columbia High-ratio Transformer
 - 1 Thordarson or Columbia Low-ratio Transformer
 - 2 Bakelite Rheostats—30-ohm
 - 2 Bakelite Sockets
 - 2 2-Circuit Jacks
 - 1 1-Circuit Jack
 - 1 Baseboard
 - 9 Binding Posts
- \$10.90**
- Diagram and Instructions for wiring.



COMPLETE PARTS FOR 3-TUBE COCKADAY RECEIVING SET

- 1 Cockaday Coil
 - 2 23-Plate Hy-Grade Cond.
 - 2 Bakelite Rheostats, 30-ohm
 - 1 Bakelite Rheostat, 6-ohm
 - 3 Bakelite Sockets
 - 1 high ratio Columbia or Thordarson Transformer
 - 1 Single Circuit Jack
 - 1 low ratio Columbia or Thordarson Transformer
 - 2 Double Circuit Jacks
 - Complete blue-prints and wiring diagrams
 - 1-Tube Set \$10.45
 - 2 3" Bakelite Dials
 - 2 Grid Leak and Mica Cond.
 - 7 Switch Points, 2 stops
 - 1 Bakelite Binding Post Strip
 - 7 Binding Posts
 - 1 Switch Lever
 - 24 ft. Hook-up Wire
 - 1 7 x 21 x 3/16" Drilled Bakelite Panel
 - 3 Bezels
 - 1 Baseboard
- \$19.95**

Our Guarantee

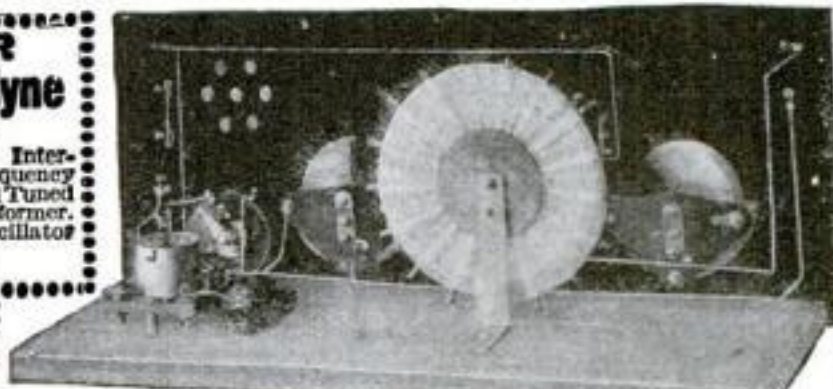
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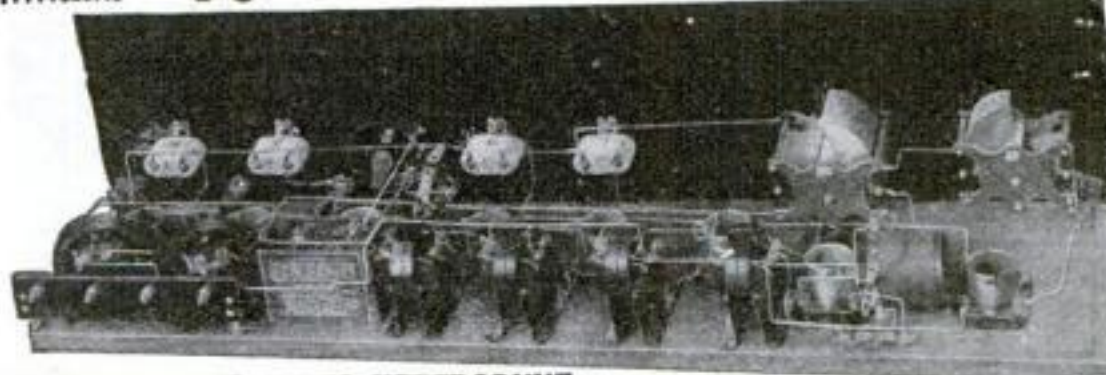
- 1 7 x 14 Bakelite Panel
 - 1 6-ohm Bakelite Rheostat
 - 1 Bakelite Socket
 - 1 23-Plate Var. Cond.
 - 1 11-plate Var. Cond.
 - 1 Genuine Reinartz Coil
 - 2 dz. Switch Points and Stops
 - 3 Switch Levers
 - 25 feet Busbar Wire
 - 1 Grid Leak and Mica Condenser
 - 1 Baseboard
 - 8 Binding Posts
 - 1-Tube Set \$10.45
- Blue-print and Complete Instructions
- 3-Tube Set..... \$17.55

Complete parts for 2-TUBE HARKNESS SET

- 7 x 14" Drilled Bakelite Panel
- 2 Harkness Reflex Transformers with Condensers
- 2 Dials
- 2 Bakelite Sockets
- 2 American Bell Transformers
- 1 Single Circuit Jack
- 1 R.W. Crystal Detector
- 1 Bakelite Rheostat 6-ohm
- 7 Binding Posts
- Baseboard and Busbar Wire
- Blue-print to complete wiring

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- Acme 1 Tube Reflex Set... \$17.45
- Acme 4 Tube Reflex set... \$39.85



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- 2 23 Plate Bremer Tully or Duplex Low Loss Condensers
 - 3 Remler or Columbia Intermediate Frequency Transformers
 - 1 Remler or Columbia Tuned Circuit Transformer
 - 1 Special Oscillator Coupler
 - 1 Connecticut Filament Switch
 - 2 Bakelite 6-ohm Rheostats
 - 1 Carter Double Circuit Jack
 - 2 Thordarson or Columbia A. F. Transformers
 - 1 7 x 30 x 3/16 Drilled Bakelite Panel
 - 1 Bakelite Terminal Strip for Binding Posts
 - 2 4" Bakelite Dials
 - 1 Dubilier 1 mfd. Condenser
 - 1 .006 Mica Condenser
 - 2 4 1/2 Volt C Batteries
 - 3 .0025 Mica Condensers
 - 1 Bakelite Potentiometer 400-ohms
 - 1 .0005 Mica Condenser and 2 megohm grid leak
 - 1 Multicolor cord for connecting batteries
- Complete wiring diagram, baseboard layout and blue print.

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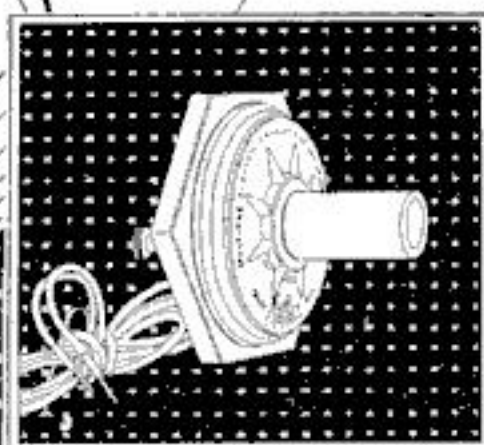
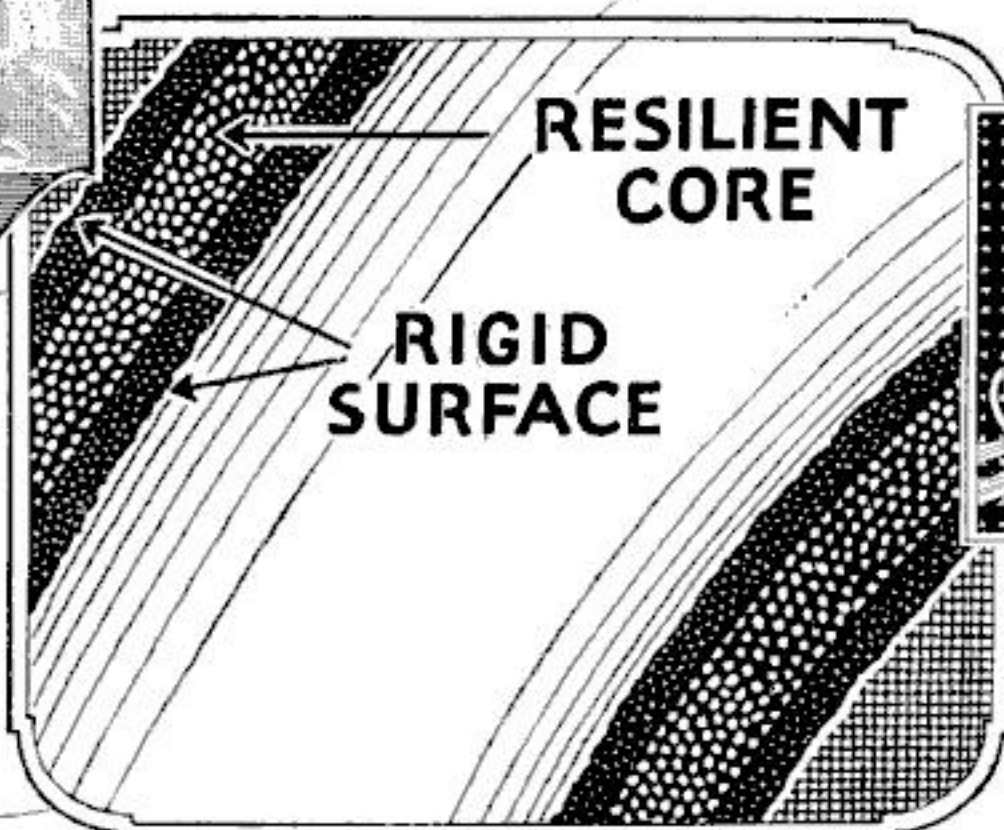
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